

ANNALS of SURGERY

VOL. LXXIII 73 JANUARY, 1921 No. 1

BONE GRAFTING: STUDY OF A SERIES OF CASES OPERATED IN U. S. ARMY HOSPITALS

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THE following information relative to the present results of bone grafts and plates has been secured from a study of such records as are available in the office of the Surgeon General, U. S. A., and the Bureau of War Risk Insurance. Among 215,423 wounded in the A. E. F., there were about 25,000 fractures, and of these 15,165 were of the long bones; thus far there have been reported 906 cases (6 per cent.) of non-union; 611 of these cases were treated by bone grafts; 189 by Lane plates; 52 by suture with wire, and 54 were sutured with kangaroo tendon or chromic catgut.

The bones involved were:

	Grafts	Plates	Kangaroo Tendon	Wire
Humerus.....	118	19	13	14
Radius.....	161	5	4	8
Ulna.....	105	8	7	..
Radius and Ulna.....	54	11	3	3
Femur.....	46	87	12	10
Tibia.....	77	34	7	14
Fibula.....	9	..	..	..
Tibia and Fibula.....	41	25	6	5

Grafts from the various bones were taken from the tibia in 338 cases, and in 98 cases a sliding graft was employed. In 25 cases pegs made from boiled beef bone were used, and in 31 cases pieces of rib.

2. *Loss of substance* between the separated ends of the fragments in those cases where it was reported, varied from 3 to 12 cm., but averaged from 4 to 5 cm. Length of the graft averaged about 8 to 9 cm.

3. *Interval Between the Injury and Time of Operation.*—From these 611 cases in which grafts were used, partial reports have been received from 570 cases as follows:

The operation of grafting was performed within one hundred and fifty days upon 86 cases; between one hundred and fifty-one and two hundred days upon 104; between two hundred and one and two hundred and fifty days upon 85 cases; between two hundred and fifty-one and three hundred and fifty days upon 160 cases, and after three hundred and fifty-one days

upon 135 cases. The average time which elapsed between the injury and operation was as follows:

Humerus, two hundred and nineteen days; radius, two hundred and thirty-six days; ulna, two hundred and twenty-seven days; radius and ulna, two hundred and forty-six days; femur, one hundred and seventeen days; tibia, two hundred and thirty-two days; fibula, three hundred days; tibia and fibula, two hundred and thirty-five days; total, eighteen hundred and seventy-two; average, two hundred and thirty-four.

In a considerable number of cases there was some slight infection which did not materially interfere with the success of the grafting, showing the marked viability of well-made grafts. One report states that in 62 per cent. of 46 cases which supplicated after operation, the graft was successful. In 95 cases the infection was extensive enough to require the removal of the necrosed graft. In some cases in which there was doubt regarding the completeness of the healing, the two-step operation was performed, preliminary excision of the scar tissue, with replacement by a healthy skin flap, and followed after a period of ten days by the final grafting.

4. *Fracture of the Graft.*—As this occurred in a considerable number of cases, precaution should be taken to carefully apply a well-fitting, plaster-of-Paris, circular case to firmly immobilize the limb. This should not be disturbed for from eight to ten weeks. Furthermore, a supporting apparatus should be worn for several weeks longer, especially for the lower extremity.

5. *Results of Treatment.*—In order to compare the results of treatment, the date is taken on which the patients applied for an examination to determine the extent of their disability and the amount of their compensation—at the Bureau of War Risk Insurance. The above date is here called the rating date. The duration of treatment between the date of injury and the rating date in fractures which were grafted was for the humerus, five hundred and nineteen days; radius, five hundred and thirty-one days; ulna, five hundred and twenty-nine days; radius and ulna, five hundred and twenty-five days; femur, four hundred and seventy-seven days; tibia, five hundred and forty-three days; fibula, five hundred and seventy-two days; tibia and fibula, four hundred and eighty-three days. In 48 per cent. of the rated cases the disability was 25 per cent. or under. In 22 per cent. of the rated cases the disability was between 25 and 35 per cent. In 22 per cent. of the rated cases the disability was between 35 and 50 per cent. And in 8 per cent. of the rated cases the disability was over 51 per cent.

The next important question is to determine the date for the grafting operation which will produce the most favorable results. The above statistics indicate that in those cases in which an interval of less than two hundred days elapsed between injury and operation a low disability of 25 per cent. was secured in 43 per cent. of the cases. Whereas in those

cases which were operated upon after an interval of two hundred days the same disability of 25 per cent. was obtained in 57 per cent. of the cases.

Summary.—In order to obtain the best results sufficient time must be allowed to elapse between the injury and the operation for the complete subsidence of the original infection, and the above figures show a more favorable recovery has followed the late rather than the early operation; that is to say, over rather than under two hundred days after injury. It is reasonably safe to operate during the fourth month after complete healing has occurred.

Grafts, autogenous, taken from the tibia have proved the most efficient material for bone grafting for fractures of the long bones, on account of its characteristic strength. They are best made with the saw and exact coaptation of parts of the graft to respective parts of the host bone must be secured.

While many of these records are as yet too incomplete to give the final end-results, yet sufficient evidence has been secured to prove that bone grafting is the most efficient method for non-union of fractures and very favorable results can be obtained in the largest percentage of cases.

THE BACTERIOLOGY OF INFECTED WOUNDS WITH ESPECIAL REFERENCE TO THE IMPORTANCE OF STREPTOCOCCUS HÆMOLYTICUS

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THE data herein presented are based on an analysis of bacteriologic work done at Base Hospital 15, American Expeditionary Forces in France.

The enormous importance of the streptococcus hæmolyticus in all clinical surgery, as well as the similarity between war wounds and certain types of accidental injuries seen by civilian surgeons, justifies the publication of this study.

In order to avoid the drawing of false conclusions it is necessary to understand the conditions under which the work was done, and the technic used. During part of the time the hospital acted as a base hospital; but, during a large part of the period covered, its function was that of an evacuation hospital, the surgical cases remaining in the wards only a short time unless very seriously injured. Moreover, the limitation of the laboratory force, due to the general shortage of laboratory men in the American Expeditionary Forces and to sickness in our laboratory staff, made it necessary that the wound bacteriologist cover other fields of work not at all related to his own. The same cause prevented the completion of some of the records, and necessitated the development of quick methods, which, while fairly accurate, were manifestly lacking in scientific completeness. Again, the shortage of personnel made it impossible usually to make cultures at all stages in the evolution of the wound. Except in a few cases, only such wounds were cultured as were very seriously infected or were in so good condition that a secondary closure was contemplated.

The principles governing the work were: First, the furnishing of assistance to the clinician, and through him to the patient, by accurate, quick, intelligible reports. Second, the gathering of statistical data if, and where, possible. The former was distinctly felt to be the first duty.

An explanation of the technic used may be of interest to those having limited laboratory facilities at their command.

Technic 1. Methods of Procuring Specimens.—The wound exudates were collected by either the bacteriologist or the ward surgeon in one of two ways. The majority were collected on cotton-tipped applicators kept sterile in test-tubes. Other exudates were drawn from the depths of wounds into sterile capillary pipettes which were resealed at the bedside immediately after collection of the specimen. The latter method

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had advantages in securing the exudate from deep, profusely discharging wounds; but for general work the swabs appeared to be more practical.

Blood cultures from cases of suspected bacteriæmia were made at the bedside by the bacteriologist, about 7 c.c. of the patient's blood being passed from a sterile syringe into about 200 c.c. of a 0.5 per cent. dextrose meat-infusion broth. No attempt was made to get anaërobic blood cultures from patients in the wards.

At autopsy, aërobic and sometimes anaërobic cultures were made from the heart's blood. About 1 c.c. of the blood was put into broth and about the same amount saved for anaërobic cultures. From the aërobic broth culture a subculture was made of blood-agar.

2. *Methods of Studying Specimens.*—From the exudates taken from wounds as above described, a direct smear was always made and a report of microscopic findings sent to the surgeon. The cultural results were reported as soon as possible.

For aërobic cultures our early technic involved the use of glucose broth, broth with meat, plain agar slants, and blood-agar plates. Later, the limited time and help, and necessary economy in the use of media led us to use only large blood-agar plates (15 cm. in diameter) for the culturing of aërobes from wounds. With that medium, a fairly accurate diagnosis of streptococcus hæmolyticus could be given in from five to twelve hours. Other aërobes were generally diagnosed from the same culture on the characters of colonies, and the morphology, motility and staining properties of the organisms. Broth cultures and slants of coagulated serum and plain agar were used for special cases. For example, *B. diphtheriæ* was demonstrated in the wound of a man who developed pharyngeal diphtheria after having been wounded.

For the rapid diagnosis of anaërobes, anaërobic broth and broth containing meat were soon discarded. The following routine technic was developed. A tube of litmus milk and a tube of 0.5 per cent. glucose agar were boiled from twenty to thirty minutes. The milk was cooled rapidly, inoculated, and covered with a layer of sterile albolin. The agar was inoculated when partly cooled or at the boiling point. Sometimes it was kept at a temperature of 100° C. for one-half to one minute or even five minutes after inoculation and then cooled quickly. The variations here noted in regard to the preparation of agar cultivations were determined by the microscopic findings in direct smears.

B. Welchii was diagnosed within twenty-four hours, principally by the morphology, lack of motility, and stormy fermentation of milk. The diagnosis of vibriion septique was based upon delayed stormy fermentation of milk, morphology, motility, and the peculiarities of the colonies in the deep agar shake. A tentative diagnosis of spore-bearing anaërobes was attempted on the morphology and motility of the organism, and on the colony appearance and odor in the cultures. When time permitted, colonies were fished and studied in subcultures. In suspected

tetanus infection, agar cultures were boiled for five minutes after inoculation, and the organisms were also studied in anaërobic cultivations prepared according to Zinsser's method.

The use of only three cultures for routine examination of each wound was adopted, not as the best scientific procedure, but as a matter of expedience determined by the amount of time and assistance available, and by the necessity for economizing materials. It gave a fairly certain, very quick diagnosis of hæmolytic streptococcus, and of staphylococcus aureus and albus, differentiating at once between the hæmolytic and nonhæmolytic strains. It permitted a general, though not very accurate, identification of other aërobes. It gave a quick and fairly accurate diagnosis of *B. Welchii* and, with less certainty, of vibriion septicæ. It permitted the partial classification of some other anaërobes.

On the other hand, the differentiation of many of the aërobic bacteria was certainly very incomplete, while even the presence of some anaërobic types was probably often not revealed by these methods. Such, however, was the system which to us seemed the most reliable and practicable under the circumstances.

Analysis of the Data Obtained.—In my series there are 276 cases for which bacteriologic records are available. Of these, 73 or 26.45 per cent. were fatal, and 203 or 73.55 per cent. were nonfatal. In noting these figures it must be remembered that most of the cultural examinations were made from the more seriously wounded. From this series of 276 wound cases the information obtained was more or less complete.

Rather interesting results have been obtained from the consideration of the following points:

1. The character of the bacterial flora found in wounds after the lapse of various periods of time.
2. The symbiosis of organisms in wounds.
3. The prognosis of cases showing the presence of certain organisms.
4. Secondary suture of wounds.
5. Gas infection.
6. The bacterial infection to be most feared in cases of gunshot wound, *i.e.*, streptococcic bacteriæmia.

Other questions were approached but my figures thereon are neither large enough nor striking enough to permit the formulation of any conclusions. These latter figures were recorded simply with the idea that they might be of use in conjunction with other reports.

1. *The Character of the Bacterial Flora Found in Wounds After the Lapse of Various Periods of Time.* Chart I shows an analysis of 358 reported bacteria isolated in 207 cultures at various periods.

The streptococcus was not only fairly frequent in the early cultivations but was extremely persistent, its incidence after two to three months being practically the same as that during the first three days after reception of the wound. Table I shows an overwhelming pre-

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ponderance of the hæmolytic variety of streptococcus, and for that reason my charts and tables show all streptococci together without reference to their hæmolyzing powers.

TABLE I
Streptococcus.

	From wounds		From the blood		Total	
Hæmolytic.....	76	95 per cent.	27	90 per cent.	103	93.64 per cent.
Nonhæmolytic	4	5 per cent.	3	10 per cent.	7	6.36 per cent.
	80	100 per cent.	30	100 per cent.	110	100 per cent.

As has been observed by others, an interesting fact to be noted in an analysis of Chart I is that the anaërobes, being very frequently present just after the infliction of wounds, become rapidly less and less frequent, later disappearing entirely. While anaërobes comprised 38.5 per cent. of the strains cultivated from wounds within the first three days after injury, the incidence of anaërobes in the cultivations made between five and eight days after wounding was only 7.3 per cent. Staphylococcus and other aërobic types as a whole were frequent, their relative frequency in infected wounds rising, of course, as the incidence of anaërobes declined. It was interesting to note that the average number of bacterial types found in the cultures, at whatever period taken, was slightly less than two.

2. *Symbiosis in Wounds.*—An attempt was made to determine what organisms will grow well together in wounds, and conversely, what associations of organisms are not likely to occur. It is seen that only six different organisms were concerned in all the ten most frequent associations. The most common association was that of the hæmolytic streptococcus with staphylococcus aureus. All the other frequent associations contained either streptococcus or staphylococcus. Another striking fact noted that staphylococcus aureus growing alone was found in many nonfatal wounds but in only one fatal wound. *B. Welchii* and other anaërobes were found as a rule to be in association with streptococcus or staphylococcus.

3. *The Outcome of Two Hundred and Twenty Cases Showing the Presence of Certain Organisms.*¹

(a) *Streptococcus.*—Streptococcus without anaërobic association gave deaths at all periods during the first four months, especially during the second month. Moreover improvement² and cure were very tardy in those cases showing staphylococcus but without anaërobes. The asso-

¹ The remarks in this section are based on bacteriologic findings in wounds, hearts' bloods, and metastatic abscesses.

² Owing to the type of our hospital, many of the cases had to be evacuated when wounds were only partially healed. Such cases are here considered as "improved." Cases evacuated unimproved numbered only two, and are not here included.

ciation of streptococcus with staphylococcus but without anaërobes gave a somewhat worse prognosis, while, in the association of streptococcus with anaërobes the prognosis was even worse.

(b) *Staphylococcus Aureus*.—Staphylococcus aureus infections showed a much lower death rate than those due to streptococcus, and the few deaths due to staphylococcus occurred during the first month. Improvement and cure were more frequent and earlier than in the case of infections with a streptococcus. As has been noted, an infection with associated staphylococcus aureus and streptococcus was considerably more virulent than an infection with either alone. The association of Staphylococcus aureus with anaërobes raised somewhat the virulence of staphylococcus infection though still the deaths were all within the first month.

(c) *Anaërobic Infections*.—It would seem that the virulence of anaërobes was increased by association with streptococcus and decreased by staphylococcus association.

(d) *Aërobes as a Whole Excepting Streptococcus and Staphylococcus Aureus*.—Wounds which on bacteriologic examination revealed only members of this group pursued a favorable course. Improvements were early and numerous; the only death in this series of cases occurred early.

(e) For comparison with my figures on the influence of the presence of various organisms in wounds, I present Table II, compiled from a

TABLE II

Bacteriology and Outcome of Cases with Gas Infection—Series of Weinberg and Seguin.

	Strept. without staph without anaërobes.	Staph. without strept. without anaërobes	Strept. with staph. without anaërobes	Strept. with anaë- robes without staph.	Staph. with anaë- robes without strept.	Strept. with anaë- robes with staph.	Anaërobes without strept. without staph.	None of preceding organisms.	Total cases.
Fatal.....	..	..	..	10 22.7 per cent.	1 16.7 per cent.	1 14.3 per cent.	27 42.9 per cent.	..	39 31 per cent.
Nonfatal.....	1	1	2	34 77.3 per cent.	5 83.3 per cent.	6 85.7 per cent.	36 57.1 per cent.	2	87 69 per cent.
Total.....	1	1	2	44	6	7	63	2	126

series of Weinberg and Seguin.³ This series is composed entirely of cases showing signs of gas infection, either gangrenous or phlegmonous. Though the element of elapsed time is lacking in the series, a good idea can be gained of the comparative virulence of the principal infections encountered. The figures, in a general way, support and supplement those from my similar cases.

³ Weinberg, M., et Seguin, P.: La Gangrene gazeuse, Monographies de l'Institut Pasteur, 1917.

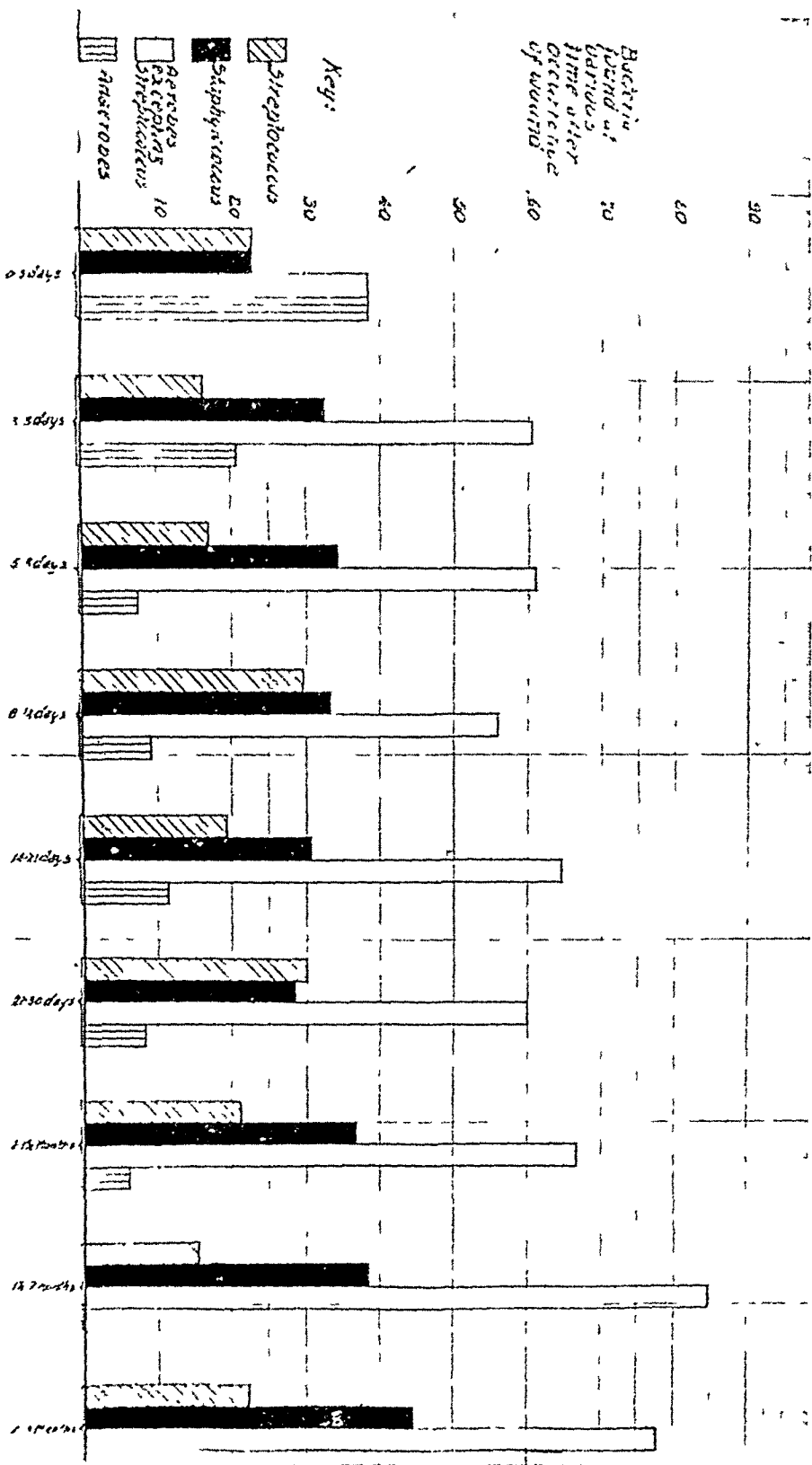


Chart I.—Bacteria found at various times after occurrence of wound. (All charts in this report based on percentage figures).

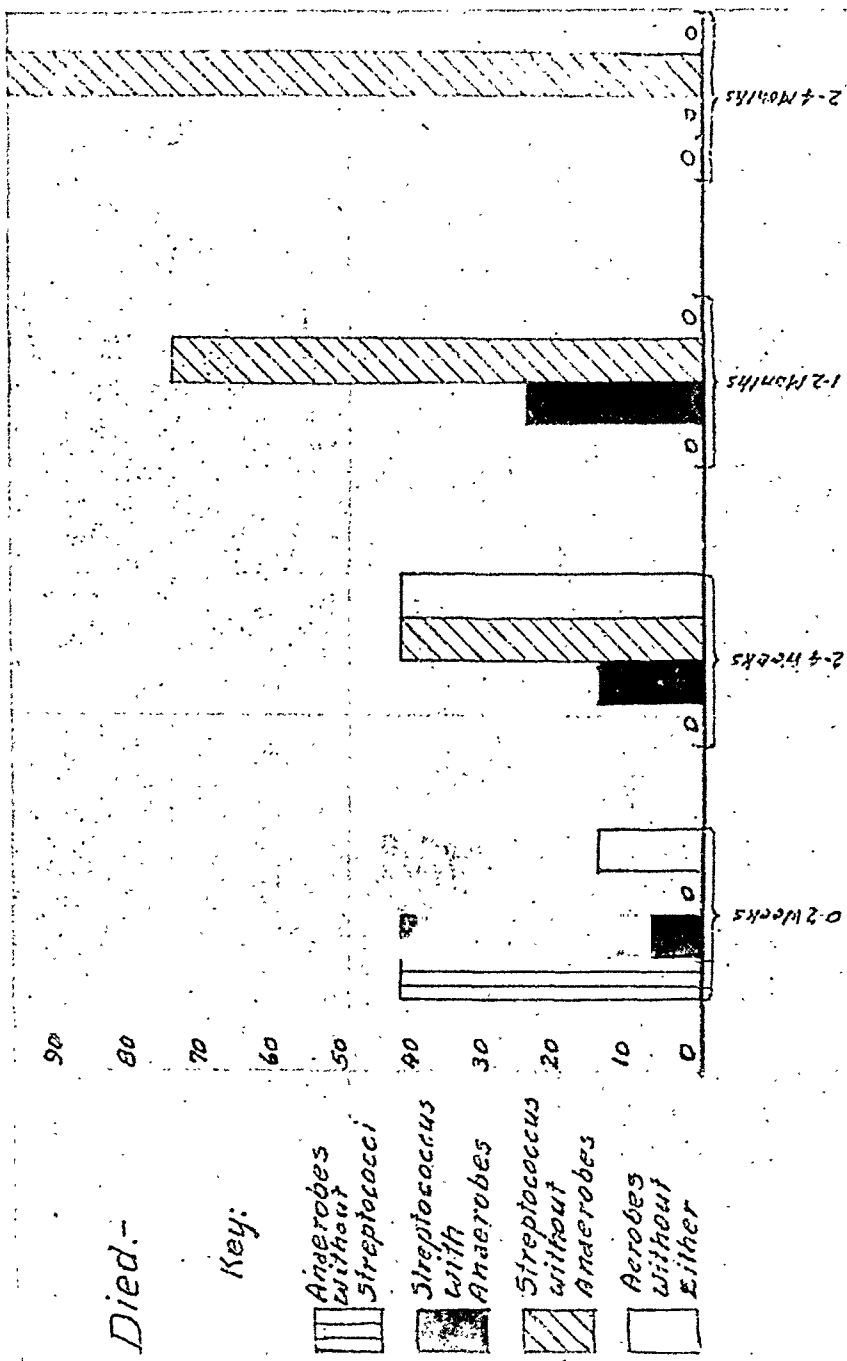


CHART II.—The prognosis of cases showing the presence of certain organisms.

4. In the preceding section an attempt was made to establish the prognosis based on bacteriologic findings. Approaching the problem from the opposite direction: Given a certain clinical progress in the wounded patient, what organisms are we most likely to find? Taking for example Chart II, we find that, of all cases dying during the first two weeks, 85.8 per cent. showed anaërobes with or without streptococcus, none of them showing streptococcus without anaërobes. On the other hand, during the second month, fatal cases showed streptococcus without anaërobes in 75 per cent. and streptococcus with anaërobes in 25 per cent. Furthermore, all cases dying more than two months after injury showed streptococcus without anaërobes. Turning to improvements and cures, we found that those occurring early were usually infections by the aërobes aside from streptococcus, though some anaërobic infections came within that class. When improvement and cure occurred only at a late date we found usually infections by streptococcus unassociated with anaërobes or by streptococcus and *Staphylococcus aureus* unassociated with anaërobes.

4b. Wound Closures Regarded Clinically and Bacteriologically.—A secondary suture was performed in a large number of cases in this hospital without bacteriologic control, or in spite of an adverse bacteriologic report. Of the 55 cases with recorded secondary suture from which one or more bacterial cultures had been made, the result of the suture is unknown in seven. Three of the cases were only attempts at partial suture with drainage. Of the 45 remaining cases of complete secondary suture, 34, or 75.6 per cent., were successful; 5, or 11.1 per cent., were failures, and 6 or 13.3 per cent. were partial failures. Over 60 per cent. of the failures and partial failures were due to infection. Now, although the average time interval between the reception of the wound and the secondary closure was just over twenty-seven days, it is to be noted that in the case of the failures due to infection the average time interval was only fifteen days. Apparently these failures were due to too great haste. Of the cases with known interval between the reception of the wound and the first medical treatment, the average length of time was two and three-tenth days; this interval before first medical treatment was much longer in the cases of failure due to infection.

5. *Gas Infection.*—My series bearing on this subject was small, but gave several clear impressions. In the first place, it was noted that more than two-thirds of the cases having anaërobes in the wounds showed nevertheless no evidences of gas infection. In most cases the anaërobes were simply contaminating, not infecting agents. Again, it was noted that all our cases showing evidences of gas infection involved a lower limb, that a large percentage of these involved the thigh, and that the majority of them did not show any involvement of the bone. Thus it seems that the heavily muscled parts of the body, especially of

the lower limb, are the parts most apt to develop gas gangrene, and that the fracture of bone is not an essential factor.

6. *The Bacterial Infection to be Most Feared in Cases of Gunshot Wound, i.e., Streptococcus Bacteriæmia.*—Most of the figures found in Table III are so small as to be of little value unless combined with those of other series. There is, however, one striking conclusion to be drawn. Of the 72 fatal cases included in this series, a culture was made from the blood either before or at autopsy in 46. That culture showed a growth in 37, or 80.4 per cent., of the 46 cases; and of the 37 positive blood cultures, streptococcus was present in 31, or 84 per cent. From this we conclude that by far the most important cause of death in wound cases was a bacteriæmia, and that a large majority of those bacteriæmias were due to streptococcus. Moreover, even if one should consider that all the cases without a record of blood culture had no bacteria in the blood, the incidence of streptococcus bacteriæmia among the 72 fatal cases would still be 43 per cent.

TABLE III
Causes of Death in Fatal Cases—Bacteria Found.

	Streptococcus	Staphylococcus	B. coli and B. proteus	Pneumococcus	B. mucosus capsulatus	B. subtilis	B. Welchii	Vibrio septique	B. sporogenes	B. tetani	Total cases.
Septicæmia pyæmia											
Septico-pyæmia.....	31	6	6	3	1	1	2	..	..	..	37
Broncho-pneumonia.....	6	3	1	2	..	..	..	..	..	..	5
Lobar pneumonia.....	3	4	2	2	..	..	..	..	..	..	5
Lung abscess.....	1	..	1	1	..	..	..	..	..	..	2
Infected hæmothorax.....	1	3	1	..	..	2	..	..	..	..	3
Meningitis.....	3	2	1	..	..	..	..	..	..	..	5
Peritonitis.....	..	1	1	..	..	1	..	..	..	..	1
Arthritis.....	5	2	3	..	..	2	4	..	..	..	6
Gas gangrene.....	4	4	2	..	..	1	4	..	1	1	9
Wound cultures.....	19	17	15	..	1	5	10	2	3	4	30
Sterile cultures of heart's blood...	..	..	..	..	..	..	..	..	..	..	9
Total deaths.....											72

Opinions Regarding the Practical Value of the Culturing of Wounds Under Circumstances Permitting Only a Limited Study.—Under the conditions of rush which prevailed most of the time at the hospital where this work was done, rapidity was of practically the same essential importance as accuracy. On account of the volume of work to be done by a limited personnel, simplicity of technic and material used was also of importance. We found that the following information could be furnished soon enough to be of value to the surgeon.

Streptococcus hæmolyticus and non-hæmolyticus could be identified with a fair degree of certainty within five to twelve hours simply by a

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culture on a blood-agar plate. The frequency and persistence of the streptococcus hæmolyticus and its evident importance in causing fatalities indicate the value of wound culturing, even if for this organism alone. Staphylococcus, though much less important, can be easily and quickly diagnosed from the same cultivation, hæmolyzing powers of the strains being noted at once. Other aërobes are apparently relatively unimportant but can be more or less accurately indicated from the same culture by colony characteristics and microscopic study. It does not seem to me that routine subcultures or further study of these organisms are worth while under such circumstances, except for special indications.

As to the anaërobes, the following has been our experience: A presumptive diagnosis of *B. Welchii* can be given in eighteen to twenty-four hours. A presumptive diagnosis of vibriion septique can often though not always, be given in twenty-four to forty-eight hours. *B. sporogenes* was diagnosed but not with assurance. The reports have been of value as indications for serum treatment. The early diagnosis of *B. tetani* could not be made with any degree of certainty. Under the circumstances, and with the methods used, no other anaërobes could be satisfactorily diagnosed within a time that would make the report of clinical value.

The practicability of wound cultures to govern the curative treatment of infections with anaërobes seems to me to be very doubtful. This is to be especially considered since figures indicate that the period of danger from anaërobic infection of wounds is the early period just after the reception of the wound, the period when complete bacteriologic study must of necessity be most difficult. It seems to me that the accepted prophylactic treatment now used so effectively to prevent tetanus infection should be extended to the prevention of the other principal anaërobic infections. This has already been done to a certain extent and could probably be further extended.

Bacillus tetani is a pathogenic organism, producing death by means of a soluble toxin. An effective antitoxin has been produced. The organism cannot be identified with absolute certainty in a very short time. Still, by the prophylactic use of the specific antitoxin in all wound cases, *B. tetani* has become one of the less-feared organisms.

In like manner, the other anaërobes of importance in wound infections produce death by soluble toxins. Effective antitoxins have been produced. Indeed, there is a considerable practical difficulty in developing a combined antitoxin effective against all the principal pathogenic anaërobes, or a means of conveniently inoculating a series of antitoxins effective against the several varieties. Still, for organisms causing death so early, and for organisms so difficult to identify rapidly and with certainty, the most effective treatment should be a routine prophylactic dose of serum for all cases of war wound.

SUMMARY

1. Anaërobes are prominent in the early bacteriologic picture of wounds but disappear in a short time. Aërobes become progressively more prominent. The streptococcus has a fairly constant incidence and is very persistent.

2. A combination of streptococcus hæmolyticus and staphylococcus aureus was the most common of all associations in wounds. That association was particularly frequent in fatal wounds. Streptococcus hæmolyticus, staphylococcus aureus, bacillus Welchii, bacillus coli communis, bacillus proteus, and to a less extent, staphylococcus albus, were the bacteria appearing most often in both the fatal and non-fatal cases.

3a. (1) The prognosis seems to have been good in cases showing staphylococcus aureus or other aërobes aside from streptococcus. Here the most interesting point is that an association with staphylococcus aureus seemed to lower the virulence of infection with anaërobes.

(2) Infections with anaërobes showed a high death rate, but a short period of danger to life, unless the anaërobes were associated with streptococcus.

(3) Deaths from streptococcus infection were numerous and occurred at least up to the end of the fourth month. The mortality was even higher where streptococcus was associated with staphylococcus aureus or with anaërobes.

3b. Conversely: Cases fatal early usually showed anaërobic infection; those dying late invariably showed streptococcus infection. Most of the early improvements and cures were cases of infection by aërobes other than streptococcus, while the improvements and cures that were tardiest generally showed infection by streptococcus without anaërobes, or by streptococcus and staphylococcus aureus without anaërobes.

4. Secondary suture of wounds failed in some cases apparently because the interval between the injury and primary surgical treatment had been too long, and in other cases because the secondary suture was attempted too soon.

5. Gas infection was most often found in wounds of heavily muscled parts of the body; fracture of bone was not an essential factor; anaërobes frequently contaminated without infecting wounds.

6. A streptococcus bacteriæmia was apparently by far the most important cause of death in cases of gunshot wound.

7. The culture of infected wounds is certainly valuable, even if only for the purpose of determining the presence of streptococcus hæmolyticus.

NOTE.—The author wishes to thank Dr. W. J. Elser, of New York, formerly chief of wound bacteriology in the A. E. F., for valuable criticisms of the manuscript.

PICRIC ACID IN OPERATIVE SURGERY*

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PICRIC acid, $C_6H_2(NO_2)_3OH$, a substitution product of phenol, has been used for many years in the treatment of extensive superficial burns, a 1 per cent. watery solution being employed. It has also been used largely by me during the past ten years in the treatment of minor cuts, extensive abrasions, severe contusions, and for minor operative surgery. Its advantages over iodine were its cheapness, its stability, its mild anæsthetic properties, and especially its lack of toxicity and irritation. Its one disadvantage was its tenacious and loud coloring of everything it touched.

During the war picric acid in 5 per cent. solution in 95 per cent. alcohol became very popular in the British Medical Service and proved quite efficacious. It was adopted, at Professor Gibson's suggestion, by the First Surgical, or Cornell, Division of the New York Hospital and has been in use now about two years. It has met with approval by all the members of the attending staff and will continue to be used until something better is offered.

A number of problems at once present themselves in relation to the use of any skin antiseptic, such as absence of irritating qualities, penetration, rapid bactericidal action, etc. The bactericidal properties of picric acid have been worked out by Doctor Wheeler of the bacteriological department and are appended.

Picric acid in 5 per cent. alcoholic solution can be applied with impunity to any part of the body except possibly the conjunctiva. I have never seen, after ten years' use, any signs of irritation from the picric acid itself, even when repeated many times at frequent intervals. Care must be taken, however, not to tan the skin too much, or blebs may form in the deeper layers and eventually mild infections ensue. This is especially true about wounds already infected, as a marked scab formation results and pus retention may occur beneath the scab.

Portions of the body subject to marked intertrigo must be watched after the use of picric acid with occlusive or irritant dressings, but less so than after the use of iodine.

Irritant chemicals such as bichloride of mercury, iodine, etc., must be used with reasonable care in conjunction with picric acid. Finally, dressings saturated with picric acid become exceedingly inflammable when dried.

* Read before the Surgical Section of the New York Academy of Medicine, March 5, 1920.

With the aid of Doctor Spencer and Doctor Kingery, of the New York Hospital, a number of experiments on guinea-pigs were carried out to determine the effect of picric acid on the peritoneum. Four healthy pigs received intraperitoneally hypodermic doses of picric acid in watery solution ranging from 2 c.c. to 1 c.c. 1 per cent. solution, and .05 to 1 c.c. of 5 per cent. solution. No ill effects whatever were observed, except that the pigs seemed slightly shocked by the peritoneal irritation.

Laparotomies were performed under anæsthesia upon these same four pigs at the expiration of six weeks. No adhesions were found and all organs appeared perfectly normal. The only preparation for these laparotomies was an application of 5 per cent. alcoholic picric acid solution to the skin, without shaving. The operator's hands were not washed, but were dipped in the picric solution. The intestines were allowed to protrude freely onto the abdominal wall and were subjected to quite rough handling with dry gauze.

The wounds were sutured and all four pigs made an excellent recovery. One died at the end of six weeks from abortion. All were subjected to post-mortem examination by Doctor Spencer and nothing abnormal was found. The conclusion seems justified that in guinea-pigs, at least, picric acid in rather large amounts does not tend to cause peritoneal adhesions. In this connection, I might also state that I have occasionally used picric acid on the stump of the appendix with no apparent ill effects.

Picric acid in alcoholic or watery solutions penetrates the skin only to the stratum corneum, as do other germicides. It is not to be expected of any of them that they can penetrate all the layers of the skin in sufficient strength to kill any of the more resistant bacteria. A certain degree of systemic absorption is said to occur, even to the point of intoxication, when applied over large areas, but it is hardly possible that germicidal properties in such dilutions have been preserved. Intoxication in any degree I have never observed even where very large surfaces were covered.

Portions of the skin were examined after treatment with 5 per cent. picric solution in 95 per cent. alcohol by means of frozen sections. The penetrating power is practically that of iodine. It must be remembered, however, that picric acid is an excellent mordant and decalcifying reagent, and its germicidal properties may last longer and extend farther for that very reason.

Skin scrapings were made after the use of the 5 per cent. picric acid solution in over thirty operative wounds. After the skin incisions were made the whole depth of the skin was thoroughly, deeply, and repeatedly scraped with a scalpel, taking care to avoid blood but endeavoring to obtain as much skin *débris* as possible. These scrapings were placed in broth tubes and then transferred to large broth flasks, so that the picric acid present might be diluted beyond any possible germicidal or even

antiseptic action. Moreover, these cultures were observed over periods of at least nine days in order that bacteria deeply hidden in the tissues might have every opportunity to develop.

Of the 27 cases in which we have been able to obtain the final result 16 were reported sterile throughout, while 11 gave growths of various kinds as follows: *Staphylococcus albus*, 5 times; *staphylococcus albus* and diphtheroids, 1; *bacillus subtilis*, 3; gram-positive bacillus, 2.

These results are about what one would expect when it is considered how thoroughly and deeply the skin scrapings were made. It is interesting to note that a similar experiment was carried out by a member of the house staff, who made repeated superficial skin scrapings on himself to the corium, using alcoholic picric acid in one series and iodine in a second series. All his cultures remained sterile.

It may be of some interest, although of no real scientific value, to state that of the 16 skin wounds reported sterile, 13 healed by primary union, 2 showed slight infection, and 1 had a moderately severe necrosis of the subcutaneous fat. Of the 11 cases which were reported not sterile, 8 resulted in primary union and 3 gave a slight infection. There was 1 infection in the wound which had been reported positive for *staphylococcus albus*, 1 positive for *bacillus subtilis* and 1 for the large gram-positive bacillus. These results are of no real significance, as the cases were unselected and were frequently contaminated at the time of operation.

It is not possible to conclude anything of positive value from the skin scrapings as to the efficacy of picric acid, except that, as was well known previously, no antiseptic penetrates all the layers of the skin with real germicidal power. In my opinion, the chief value of picric acid lies not in its germicidal power, but in its tanning qualities. I believe the bacteria are mechanically caught and held in the thick pellicle of tanned skin which develops after the use of picric acid. This prevents the bacteria from readily entering wounds during the operative procedure and holds them enmeshed until the wound is sealed. The condition of the lips of the wound at the end of operation is markedly different from that seen after the use of iodine. In the latter case the iodine is largely gone, into the wound, on the towels, sponges, etc., but with picric acid this is not so, practically all being present, no matter how long the operation. Indeed, one of the chief objections to its use is the difficulty of removing the stain.

A number of attempts have been made to find some reagent which would remove picric stain from the skin, but so far none with any great promise. Any of the sodium hypochlorite solutions will act, but slowly. The lime-and-soda scrub is more efficacious but hardly applicable where most needed, *i.e.*, on the face, neck and ears. Towels, dressings, etc., are readily decolorized by simple washing in cold water.

Professor Gibson has recently called my attention to the marked im-

provement in the end-results of our chronic appendicitis cases¹ since the introduction of the picric-acid technic. In former years our percentage of bad results in these cases was very high, running about 28 per cent. Since the introduction of the picric-acid preparation the percentage has dropped from 28 to 20 in 1918, and 11 in 1919. It was noticeable, also, that the great majority of these cases complained of pain in the immediate neighborhood of the incision, presumably due to adhesions. These complaints have become markedly less during the past two years. The criticism may be made, that our better results are due to other factors; but our technic has remained identical, with the exception of the introduction of picric acid, and it is hard to believe that diagnostic acumen and operative skill have increased to any such marked degree.

In conclusion, picric acid is ideal as a skin application preceding operation in that it never irritates and that it remains in the skin for a long period of time. Its only drawback is its rather startling color, which may annoy sensitive patients when exposed surfaces are stained. From the clinical standpoint, our results compare very favorably with those formerly obtained with iodine and with the older methods of skin preparation. I am fully aware, however, of the pitfalls of clinical observations uncontrolled by laboratory findings.

All methods of skin sterilization must necessarily fail of complete satisfaction. We are forced to employ those which experience proves reasonably satisfactory until such time as the bacteriologists perfect a universal or polyvalent immunization agent, to prevent and control sepsis from whatever source.

I wish to extend my grateful thanks to Doctors Stillman, Wheeler, and Spencer, of the Laboratory Staff of the New York Hospital, and to Doctors Kingery and Durfee, of the House Staff, for valuable aid in the technical part of this work.

RÉSUMÉ OF BACTERIOLOGICAL PROCEDURES

The tests to be described were carried out with samples of tincture of iodine and of 5 per cent. picric acid in 95 per cent. alcohol obtained from stock solutions in the operating room.

The phenol coefficients of these two solutions were determined by the United States Hygienic Laboratory method. With no organic matter present, the 5 per cent. picric acid solution had a phenol coefficient of 0.35; the tincture of iodine, a coefficient of 15.5. In the presence of organic matter—gelatin and peptone—the coefficients were

Year	Per Cent. Unsatisfactory	Year	Per Cent. Unsatisfactory
1913	28	1917	24
1914	23	1918	20
1915	28	1919 (6 months).....	11
1916	26		

Gibson, Charles L.: The Results of Operations for Chronic Appendicitis. Am. Journ. Medical Sciences, May, 1920, No. 5, vol. clix, p. 655.

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0.2 for the 5 per cent. picric acid solution and 12.5 for the tincture of iodine. A control test with 95 per cent. alcohol, no organic matter present, showed a coefficient of 0.15.

In determinations of this kind, intimate contact between the disinfectant and the test organism is assured, since they are mixed in a liquid medium and thoroughly shaken. The results obtained, however, give little information as to the efficacy of the disinfectant when applied to the skin, for in the latter case contact between disinfectant and organism depends upon the penetrating power of the solution, upon its ability to reach organisms that may be underneath the superficial layer of cells, in the ducts of sweat glands or in hair follicles.

In order to make the conditions of the tests conform more closely to those that obtain when these disinfectants are used for skin sterilization, the method devised by Elser and described by Connell² was employed. In this method the results depend upon the ability of the disinfectant to penetrate non-liquid culture media. Culture tubes of uniform calibre containing standard nutrient agar medium are inoculated, while the medium is liquid at 45 degrees Centigrade, with equal amounts of a 24-hour culture of staphylococcus aureus. After thorough mixing the medium is allowed to solidify. Equal quantities of the disinfectants to be tested are then added to the tubes, the cotton plugs are paraffined to prevent evaporation of the alcohol, and the cultures are incubated at 37 degrees Centigrade for 24 hours. A control culture to which no disinfectant has been added shows a uniform growth throughout the entire column of agar. The inhibiting effect of the disinfectant solution is shown by an absence of growth in that part of the medium nearest the disinfectant—that is, in the upper part of the agar column—and comparisons between different solutions may be made by comparing the heights of these zones in which no growth occurs.

Four disinfectants were tested by this method with the following results, the heights of the inhibited zones being expressed in millimetres:

- | | |
|---|-------------------------------------|
| 1. 5 per cent. picric acid in 95 per cent. alcohol: | 3. Alcohol, 95 per cent.: |
| Undiluted 12 mm. | Undiluted 10 mm. |
| 1-10 3 mm. | 1-10 2 mm. |
| 1-50 1 mm. | 1-50 No inhibition of growth. |
| 2. Tincture of iodine, 7 per cent.: | 4. Phenol in aqueous solution: |
| Undiluted 13 mm. | 1-20 2 mm. |
| 1-10 4 mm. | 1-50 No inhibition of growth. |
| 1-50 2 mm. | |

All dilutions were made with sterile, distilled water.

These results indicate that the practical value of a disinfectant may be more accurately estimated from a study of its penetrating power than from its bactericidal properties, as determined by phenol coefficient tests. The solvent employed in making such solutions also has an important bearing upon their action; iodine, when mixed with sterile vaseline in proportions of from 0.5 per cent. to 2.0 per cent., shows no inhibiting effect when tested in the manner just described.

² Connell, Karl: A New Disinfectant. Surg., Gyn. and Obst., July, 1918, vol. 27, p. 81.

INTRACRANIAL AËROCELE FOLLOWING FRACTURED SKULL*

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REPORTS of cases of air within the cranial cavity as a result of trauma to the skull are extremely infrequent. It has been thought worth while, therefore, to put on record an instance of this condition, and in addition, to summarize the cases previously reported in the bibliography so far as can be obtained.

In 1913 Luckett¹ reported the case of a machinist who received a fracture of the frontal bone from a trolley-car accident. Twelve days later he was apparently normal mentally. A week after this, periods of confusion and melancholy ensued. He had a leucocytosis of 15,000 and choked disks. X-ray showed the ventricles dilated and filled with either gas or air. At operation an opening was made in the right subtemporal region. Slight meningitis was noted. A needle was introduced into the right lateral ventricle and removal of the trocar was followed by spurts of air. An opening was made in the suboccipital region and a small rubber drain inserted into the cisterna magna. Cerebrospinal fluid mixed with air escaped from here also. The patient died on the fourth day after operation. At autopsy, air was found in the ventricles. The fracture was found to communicate with the frontal sinus, and over the fracture there was a laceration of the right frontal lobe. It was surmised that an attack of sneezing had forced air from the frontal sinus up into the ventricle.

Skinner² reported in 1916 a case of intracranial aërocele which lay beneath the dura of the right frontal lobe. The patient had sustained a fractured skull in a gas-well explosion four weeks previously, but complained of persistent headaches and dizziness. At operation the gas was collected from the cavity by putting a needle through the dura, and on chemical examination proved to be air from which a large per cent. of the oxygen had been absorbed. The origin of the aërocele was, therefore, probably from a crack extending into the frontal sinus. After a good operative recovery the patient succumbed on the twentieth day to meningitis.

In 1918 Holmes³ reported the following case. The patient, an aviator, sustained a skull injury which the X-ray showed to be a linear fracture through both tables of the frontal bone, involving the frontal sinus. In addition to this fracture the plate disclosed a "large, oval, irregular area of diminished density in the frontal region." One week later symptoms of meningeal irritation developed and plates were repeated. The area of

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diminished density was still present, but less extensive. A diagnosis of intracranial aërocele was made and the patient was operated upon. An area of bone was removed over the frontal region exposing dura, and the latter incised. Two ounces of turbid serum and air were evacuated from beneath the dura and the wound closed with drainage. The patient died of meningitis.

Holmes also quotes an unreported case of Doctor Dodd's in which there was air in the ventricles following a fractured skull. No further details were given.

Glenard and Aimard⁴ in 1919 published details of a case of traumatic aërocele of the brain, in which attention was called to the sequence of events in the air-containing cavity. They emphasize the fact that no mental symptoms were present in their patient, although the defect was a relatively large one, occupying a position between the frontal and temporal lobes of the left side. The original injury was from a small piece of shell which entered the skull in the forehead, slightly to the left of the midline, and after traversing the left frontal lobe, made its exit through the temporal fossa. Several weeks after injury, X-rays of the head showed an air-containing area above and somewhat anterior to the region of the exit of the missile. A few weeks later still, this area contained partly air and partly cerebrospinal fluid, and there was a discharge of the latter from the patient's nose. Eventually the entire cavity became filled with fluid. The man died of intercurrent disease nearly a year after his injury. Barbé and Glenard⁵ reported the autopsy finding, which consisted in a cavity containing 25 c.c. of lemon-yellow fluid, occupying a position between the left frontal and temporal lobes.

A case of hydropneumocranium with air in the ventricles was published in 1919 by Potter.⁶ His patient, a man aged forty years, sustained a skull fracture without loss of consciousness. X-ray examination showed a stellate, comminuted fracture involving the frontal sinus. Inside the skull at the site of injury, there was a gaseous accumulation the size of a small hen's egg. Two weeks after injury there was an increase in volume of the subdural gas and partial filling of the lateral ventricle with the gas also. Two months from the time of the initial trauma all traces of air had disappeared.

In 1919 also, May⁷ briefly outlined the findings in the case of a woman aged fifty-five years who had been knocked down by an automobile and remained unconscious up to her death twenty-four hours later. A post-mortem X-ray of the head showed numerous radiating fracture lines to the vault, base and into the frontal sinus. In the frontal region, apparently in the substance of the brain, there was a large air space.

CASE REPORT.—A. R. T. (Surg. No. 11081), a girl aged nineteen years. Admitted to the Peter Bent Brigham Hospital September 2, 1919. Family and past history unimportant.

Present Illness.—On June 9, 1919, she was thrown out of an automobile when it ran into a trolley car and was picked up unconscious. Taken at once to a local hospital; she was operated upon the same day. Notes from this hospital are as follows: X-ray examination showed a compound, comminuted and depressed fracture of the skull, extending from near the vertex, slightly to the left of the midline downward and forward through the left orbit. Linear fractures extended backward to the occiput, forward through both orbits, and presumably through the base of the skull. All loose bone fragments were removed at operation, and hemorrhage controlled. There was considerable laceration and loss of substance in the left frontal lobe. The wound was closed, leaving a small drain. Her post-operative course was uneventful.

She came to the Brigham Hospital on the service of Dr. Harvey Cushing three months after her injury because of (1) weakness of right side of face; (2) blindness of right eye; (3) deafness of right ear, and (4) loss of sense of smell.

Neurological Examination.—*Cranial nerves.* Olfactory—Complete anosmia on the left; nearly complete on the right.

Optic—Fundus O.D.—well-marked primary optic atrophy. Fundus O.S.—beginning primary optic atrophy. Temporal hemianopsia of left eye—not complete.

III, IV, VI.—Left pupil larger than right. Right pupil reacts very sluggishly to light, but consensual reaction is normal. Partial palsy of right internal and superior recti muscles. Slight ptosis of right eyelid.

Trigeminus—Normal.

Facial—Complete right facial palsy, with absence of taste on anterior two-thirds of right side of tongue.

Acoustic—Nearly complete loss of hearing—both air and bone conduction on right side.

IX–XII—Normal.

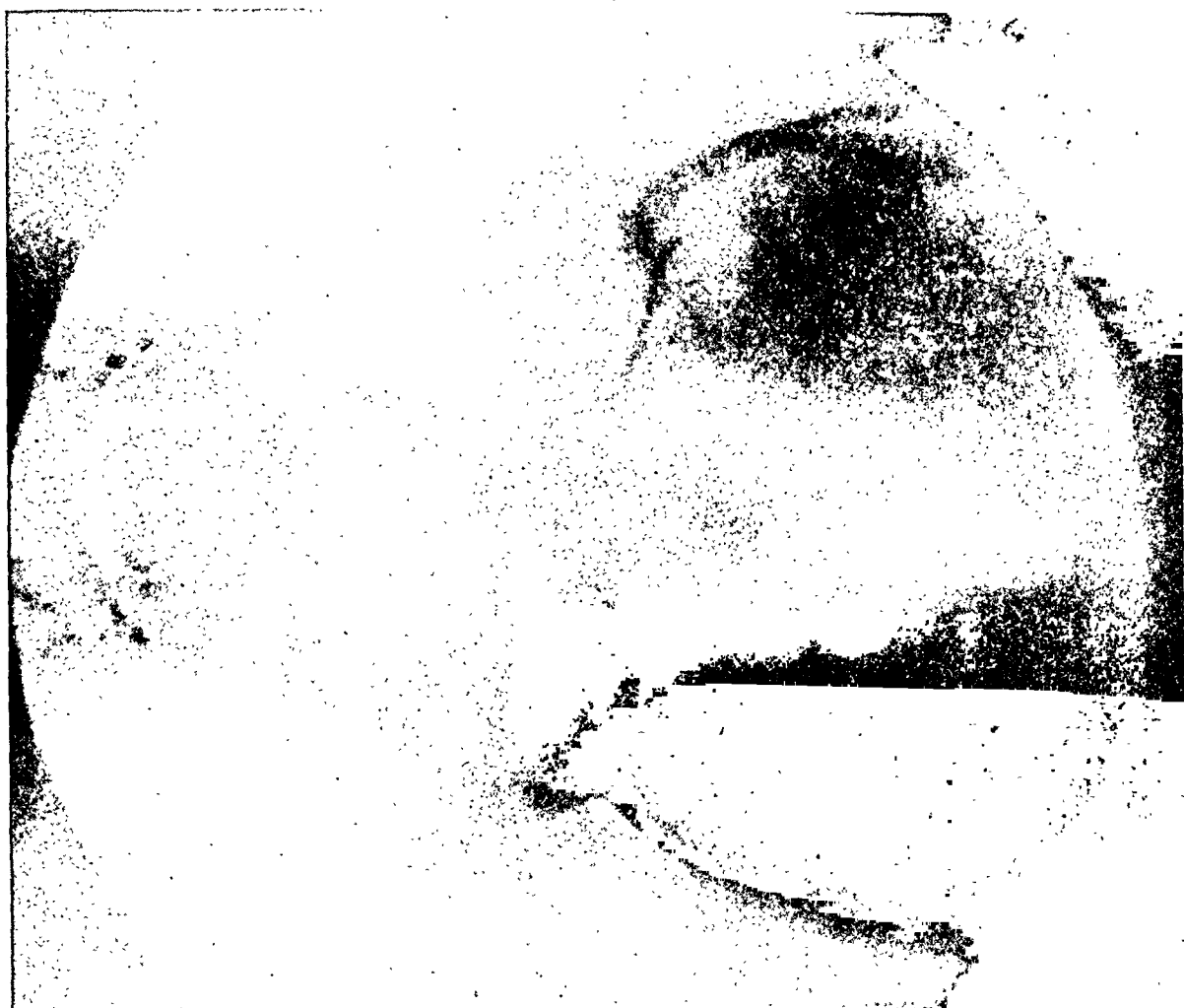
Cerebrum—The only indication of cerebral damage was referable to the frontal lobes. The patient seemed to be rather too casual in her attitude. She had almost no realization of her condition, and no special regret for the disfigurement of her face—facts which in a perfectly normal girl would cause considerable annoyance. No symptoms referable to the cerebellum.

Reflexes—Normal throughout.

No vasomotor or sphincteric disturbance.

Head—Palpation revealed a cranial defect over the left frontal region, extending from near the vertex down to the left orbit. X-ray of the skull showed an area of decreased density corresponding to the palpable defect in the cranium. It extended from the left frontal sinus upward for a distance of $6\frac{1}{2}$ cm., and was 4 cm. in its greatest width.

Upon comparing this X-ray with some others which the patient had brought with her to the hospital, it was evident that another,





and somewhat different area of decreased density had been present at an earlier date, in addition to that due to the defect in her skull. The previous plates had been taken July 8, 1919, two months before her admission to the Brigham Hospital, and one month after her initial injury and operation. At this time they showed the area due to the cranial defect just as described above.

In addition to this area, there was to be seen underlying the bony defect, a lobulated shadow of decreased density (Fig. 1) which looked like a conglomerate mass of bubbles, the picture being such as to leave no doubt but that this irregular area represented an accumulation of air within the cranium. Its extension backward within the cerebral tissue of the left frontal lobe for a considerable distance was shown by the lateral plate (Fig. 2). The origin of this gaseous matter—presumably air—was unquestionably from a crack involving the frontal sinus.

Discussion.—As mentioned previously, there are peculiarly few accounts in the literature of such air-containing cavities in the brain, and this seems the more strange because the condition must occur fairly frequently after cranial injuries of many sorts, both gunshot wounds or fractures from other causes. Again after intracranial operations there must often be inclusions of air which lie surrounded by cerebral substance, either covered by dura, or below places from which the dura has been purposely removed. Apparently no specially significant features are associated with such inclusions, either in the way of subjective sensations, or in the manner of wound healing, except their possible relation to subsequent "traumatic cysts" as mentioned by Potter. Of the seven cases recorded, four died as a result of the injury or its complications.

Recently it has been shown experimentally by Dandy^{8, 9} that air can be introduced into the cerebral ventricles, or into the spinal subarachnoid space,¹⁰ and this fact has been utilized clinically for the confirmation or determination of certain pathological intracranial processes. In Dandy's experience, no deleterious results have followed such injections, except an occasional headache which is easily relieved by ventricular puncture.

In regard to the time required for air to be absorbed from the cranial cavity we have little accurate information. In Skinner's case the residual nitrogen from a presumable original air inclusion was present four weeks after injury. That the nitrogen is the slowest of the air gases to be absorbed is, of course, well known, as this fact is made use of for therapeutic purposes in artificial pneumothorax.

Dandy says in his article on experimental introduction of air into the ventricles that, "day by day the air shadow diminishes and gradually disappears." In a case of internal hydrocephalus it required two weeks."

From the other case reports included here we get rather indefinite information. In the case of Glenard and Aimard there was a gradual supplanting of the air by fluid during the course of approximately two

months. Potter also, in his report, says that all traces of air had disappeared after two months.

In the writer's case, the skull injury occurred on June 9, 1919, but no reference to air within the cranial cavity was obtained until the plates of July 8, 1919, were taken. All that can be said is that between this time and September 2, 1919, when the final plates were made, the air had disappeared and had caused no serious symptoms so far as could be learned from the history. No operative measures seemed indicated and the patient was consequently discharged.

(I am indebted to Dr. Harvey Cushing for his permission to report this case.)

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SQUAMOUS-CELL EPITHELIOMA OF THE THYROID

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THE title indicates a tumor of the thyroid gland which can not arise primarily from the normal epithelial structures of the gland, as the follicles are lined by a single layer of cuboidal cells. The gland develops from the pharyngeal mucosa, which mucosa during its embryonic state is of a single layer of columnar cells. This indifferent arrangement of columnar cells in single layer formation remains through the descent until the gland reaches its usual situation, where the epithelium is changed to a follicular formation of a cuboidal type. A reversion of this cuboidal type (post-embryonic) to a columnar (embryonic) in the adult thyroid results in hyperthyroidism. These changes, embryonic to post-embryonic, represent most striking examples of epithelial metamorphosis both in structure and function.

The foramen cæcum lies at the junction of the anterior and posterior portions of the tongue which developed from the body of the first and a portion of the second visceral arches and from the ventral ends of the second and third visceral arches respectively (Fig. 257, Kiebal and Mall, "Embryology"). About the same time the first pharyngeal pouch is formed the anlage of the thyroid appears and it lies between the first two ventral pharyngeal grooves, and the pharyngeal membrane, the dividing line between the ectodermic and endodermic cavities, disappears, leaving remnants also for possible inclusions. The endodermic and ectodermic portions of the pharyngeal pouches and pharyngeal membrane are in intimate contact before the thyroid starts its descent, and descending later between the anlagæ of the anterior and posterior portions of the tongue which are from the first, second, and third visceral arches, one can readily imagine an inclusion of a portion of these arches and membrane; which included portions later may proliferate, resembling malignancy of their related tissues (embryonically speaking). The basal layer of these misplaced tissues may proliferate, and if we accept Krompecher's classification of spinous and basal-cell epithelioma, we might expect spinous and basal-cell types in the thyroid. Probably the case of Delherm and Laignal-Lavastine, and Herrenschmidt's two cases (herein reported) might resemble the basal type, but photomicrographs or more accurate drawings must be presented for study. In the early embryo in the region of the stomodeum, pharyngeal membrane, branchial arches and pharyngeal pouches we have at first a simplicity of structure which later presents most varied and complex pictures, all derivatives of the cephalic intestine. According to Herrenschmidt, this region and its derivatives "possess from their formation an ectodermic tendency, which, trans-

mitted in the latent state to the basal cells of its adnexæ, is susceptible of becoming manifest on the occasion of the development of an embryonary tumor." Such complex epidermoid pictures, stratified squamous epithelium, basal and spinal, are not infrequently seen in epithelial malignancy of the compound diverticuli of the buccal mucosa (salivary glands).

Theoretically, a malignant proliferation of the cells lining the follicles of the thyroid might be called an epithelioma, resembling a basal-cell type, since these cells developed from pharyngeal epithelium; but since the cells of the embryonic pharynx have undergone such a marked change I think the term epithelioma from a structural and functional standpoint should not be applied to a malignant condition of the gland arising primarily from its follicles. Malignancy of the normal follicles of the thyroid, being glandular in function and arrangement, should be termed adeno-carcinoma, and can be divided into four major types, with varying pictures between, depending upon the primary cellular proliferation of the gland.

The first type is the proliferation *en masse* of a portion of the gland whose follicles have never functioned, such a portion in its benign state being known as a fetal adenoma. When a portion of this embryonic structure (fetal adenoma) becomes malignant it retains its original structure and the microscope shows masses of fetal follicles lined by a single row of cells advancing *en masse* as a new growth. This we might call *embryonal adeno-carcinoma* (Fig. 1). The second type shows the proliferation of adult follicles advancing as a malignant mass with also proliferation of the cells lining these malignant follicles but not penetrating the basement membrane. This we might call *adult follicular papillary adeno-carcinoma*, because the follicles of the adult type are proliferating as a whole and are in turn lined by proliferating cells resembling papillæ (Fig. 2). The third type is probably the most frequent and represents a proliferation of the follicles *per se*, in which the typical glandular formation is adhered to. This type we can term *plain adeno-carcinoma* (Fig. 3). The fourth type is the proliferation individually or *per se* of the epithelial cells lining either the adult or the fetal follicles, which proliferation penetrates the basement membrane showing masses of cells advancing without structural formation. This is the only type that shows cells advancing *en masse* with no basement membrane surrounding any portion of the cells, and is known as *plain solid carcinoma* of the thyroid because it has no other formation and cannot be classified as any other type (Fig. 4). It is less frequently seen than the first two types.

In describing a case of primary epithelial malignancy or carcinoma of the thyroid, the above terminology might perhaps be used in order to standardize the pathology of the gland. Epithelioma of the thyroid should be reserved for that extremely rare state in which the malignant picture is made up of stratified squamous epithelium resembling stratified squamous-cell epithelioma of the skin (Figs. 5 and 6). The French and

SQUAMOUS-CELL EPITHELIOMA OF THE THYROID

German authors frequently use the term pavementous epithelioma, which we might accept as a squamous-cell type. Squamous-cell epithelioma or just plain epithelioma of the thyroid is extremely rare. Twenty-two cases are reported as epithelioma, but nine only are acceptable, nine doubtful, and four can be definitely ruled out.

ACCEPTED CASES

CASE I.—BUFNOIR and MILIAN: *Epithelioma pavementeux du corps thyroïde ayant pénétré dans le trachée*. Bull. Soc. anat. de Par., 1898, lxxiii, 251.

Case, female, aged fifty-two years. "Entered hospital for cough and severe dyspnoea, dying a few hours later. Presented a tumor in the thyroid (which side not stated) of six months' duration, size of an orange, very hard, whitish in color on cross-section, with vegetations on the interior of the trachea which tended to obstruct it. Lymphatic nodes of the neck were not involved. Histological examination showed the tumor to be a characteristic pavement epithelioma, very rare and arising from inclusions of the external capsule of the gland (Wölfler)."

NOTE.—The capsule is fibro-elastic tissue, of mesodermal origin and would more likely result in sarcoma.

No metastases were reported.

CASE II.—LÜCKE, A.: *Cancroid der Schilddrüse mit sehr acutem Verlauf*. Arch. f. klin. Chir., 1867, viii, 88.

Case, male, aged thirty-six years. "No history of goitre. One year ago left side of the neck enlarged with local pain. Difficult respiration began with the tumor formation. Tumor removed, but patient died a few days later from septicæmia. Autopsy showed larynx, trachea and œsophagus compressed as well as both carotid arteries. The tumor lay mostly beneath the left clavicle, compressing the left subclavian vein. There were four walnut-sized lymph-glands adjacent. Histological examination showed indifferent cell formation, some with the structure of spindle-cell epithelium and others with pavement epithelium. The majority of the characteristic epithelial cells were filled with fat, with here and there colloid globules."

NOTE.—The author did not mention pearl formation. His diagnosis was a cancrioid of the thyroid. The rapid growth was the particular feature. Evidently he considers this a squamous epithelioma if his idea of a cancrioid is similar.

CASE III.—SAVY, P., and FLORENCE, G.: *Epithelioma ectodermique du corps thyroïde*, Prov. Med., 1913, xxiv, 77.

Case, female, aged seventy-five years. "Comatose on entering hospital, no history. Tumor in right side of thyroid and large masses in iliac fossa. Autopsy showed a large yellowish colored mass, containing no blood-vessels. Left lobe not involved, but contained benign adenomata. Nodular masses found in the kidneys, suprarenals, liver, pancreas and lungs. Histological examination showed the thyroid tumor and the metastases of the same structure; viz., numerous epithelial globules formed of narrow concentric cells of ectodermic origin."

NOTE.—This tumor grew in the right side and metastases were found.

CASE IV.—BONN, H. K.: *Malignant Epithelial Growths of the Thyroid*. Jour. Ind. St. M. A., 1919, xii, 67.

Case, male, aged fifty years. "Tumor upper pole thyroid twenty years, recent growth with change in voice and spells of choking. Operation removed mass 5 x 3 inches and isthmus. Extension found in deep planes of neck. Pathologist reported no normal thyroid tissue in this tumor, which consisted of

squamous epithelium with many laminated whirls of flattened cells. Diagnosis squamous carcinoma of thyroid."

NOTE.—There were no reports of metastases.

CASE V.—KAUFMANN, C.: *Sechs weitere Falle von struma maligna. Deut. Zeitschr. f. Chir.*, 1880, xiv, 25.

Case, male, aged forty years. "Goitre since boyhood equally developed on both sides. Recently left side enlarged with pain in ear and shoulder of the same side. Difficult respiration and speech with pressure symptoms. A hard-feeling tumor the size of a child's head was felt in the left side of the neck, with involvement of the skin, and palpable lymph-glands in the neck. No operation, patient dying one month later. Autopsy showed tumor involving sternum and clavicle. The right lobe of thyroid was not involved, the trachea and œsophagus were markedly compressed and the lymph-glands along the carotid greatly enlarged but were not malignant. There were no metastases found any place. The tumor was pale and bloodless on gross section. Histological examination showed an irregular mass of cornmeal cells of a pavement type, arranged in cancrioid pearls, .04 x 0.1 mm. in diameter. The cancrioid cells involved the skin but no other tissue."

NOTE.—He states that this is the third case reported. Kocher, *Deut. Zeits. f. Chir.*, Bd. 91, relates a case which is evidently this one reported by Kaufmann. He ascribes the cancrioid, squamous-cell epithelioma of the thyroid to the remains of the thyroglossal duct, since the cancrioid is generally found on the left side, where the duct usually lies.

CASE VI.—BUSACHI, T.: *Cancro a cellule pavimentose della ghiandola tiroidea. Gazz. d. osp. e. d. clin. Napoli*, 1891, xii, 561.

Case, male, aged eighteen years. "Tumor in left lobe size of man's fist, compressing trachea and œsophagus against vertebræ. No metastases were found at autopsy. In gross the tumor was hard and of a pale yellow color. Under the microscope the tumor presented a large number of pavement cells of various forms, some of which had undergone cornmeal transformation similar to those in epithelial pearls; a typical pavement-cell epithelioma."

CASE VII.—WOLFENDEN, R. N.: Epithelioma of the Thyroid Gland and Trachea. *Jour. Laryngol.*, London, 1890, iv, 50-53.

Case, male, aged fifty-five years. "Trouble began six months previously with difficulty in swallowing, which gradually increased with loss of weight, dysphagia and dyspnœa. Hard, tender, freely movable tumor in right side, size of an orange; left side of thyroid negative and no enlarged glands. Laryngoscope showed large red swelling under vocal cords with marked tracheal stenosis. Died during operation. Autopsy showed growth in right lobe and isthmus of a pale yellow-grayish color, hard and bloodless, with the left lobe normal. Microscopic report; viz., squamous-cell epithelioma."

NOTE.—Autopsy was confined to throat and no report of metastases was given.

CASE VIII.—EPPINGER (quoted by Kaufmann): *Carcinoma glandulæ thyroideæ. Praeger Vierteljahr f. prak. Heilkunde*, 11, 13.

Case, male, aged forty-seven years. "Ill several years, heart trouble and dyspnœa. Patient died in hospital. Autopsy showed a tumor involving tissue from the upper sternum to vertebræ, springing from the inner and under parts of the thyroid. The tumor involved the trachea, œsophagus, aortic arch, superior vena cava and surrounded by firm adhesions. The histological examination disclosed a pavementous epithelial carcinoma."

NOTE.—The author notes that only one other such case has been reported, that of Lücke, whose case was reported as a cancrioid, which is included in this series. From this reference and the use of the term pavementous epithelial carcinoma we can accept it as a true squamous-cell epithelioma.

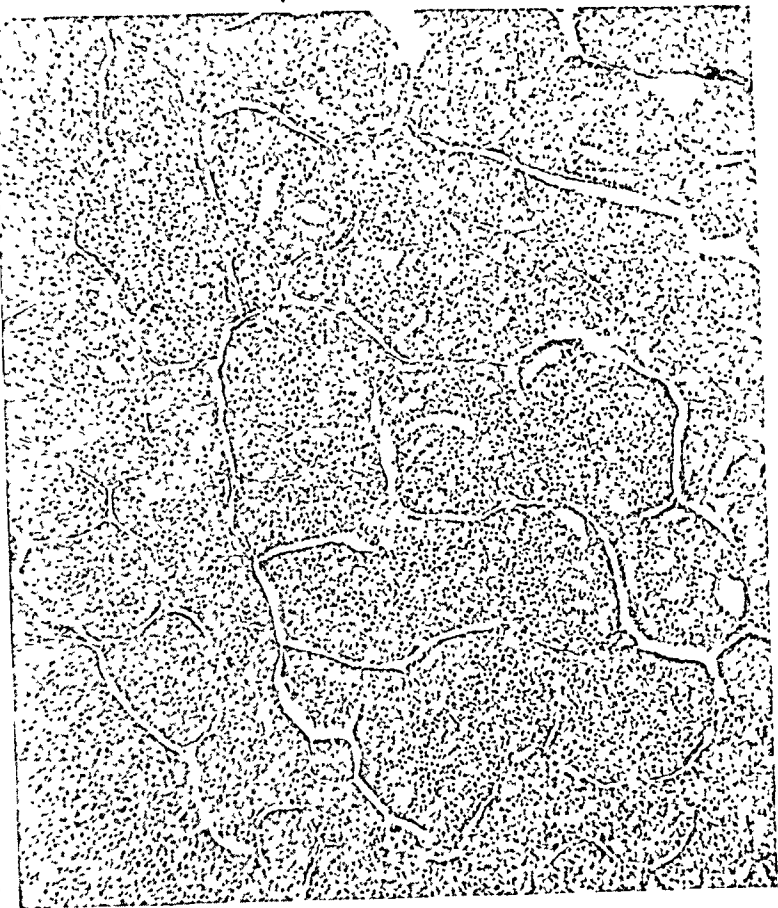


FIG. 1.—Embryonal adeno-carcinoma. Malignant fetal adenoma. (Photo mic. furnished by A. C. Broders, Rochester.)

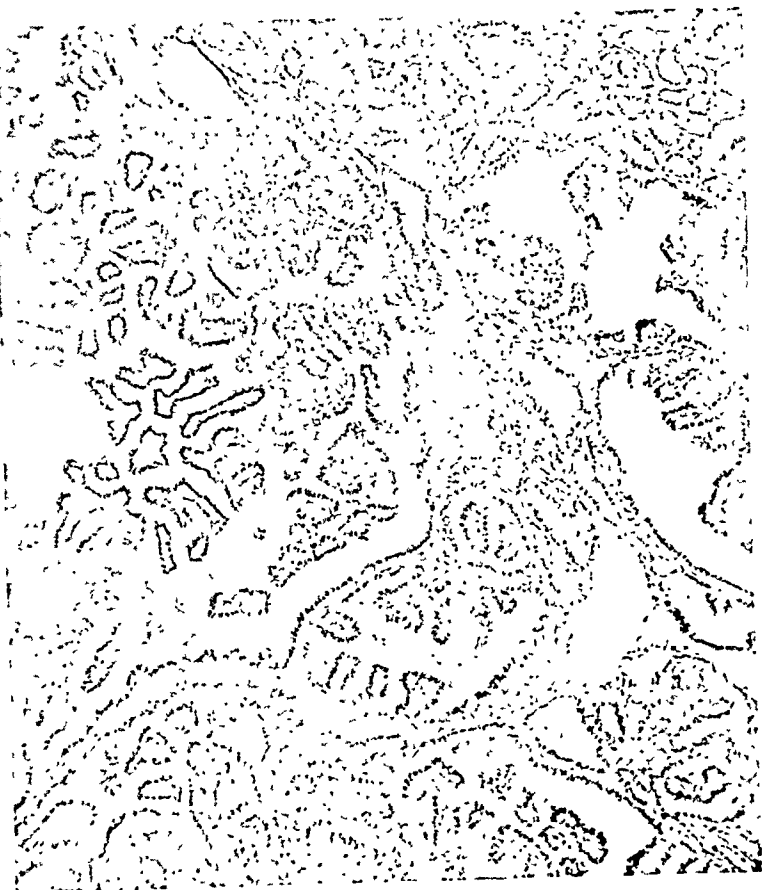


FIG. 2.—Adult follicular papillary adeno-carcinoma. The cells inside the follicles are proliferating and the follicles as a whole are advancing en masse. (Photo mic. furnished by A. C. Broders, Rochester.)



FIG 3 —Plain adeno carcinoma The follicles are advancing en masse as a simple glandular structure (Photo mic furnished by A C. Broders, Rochester)

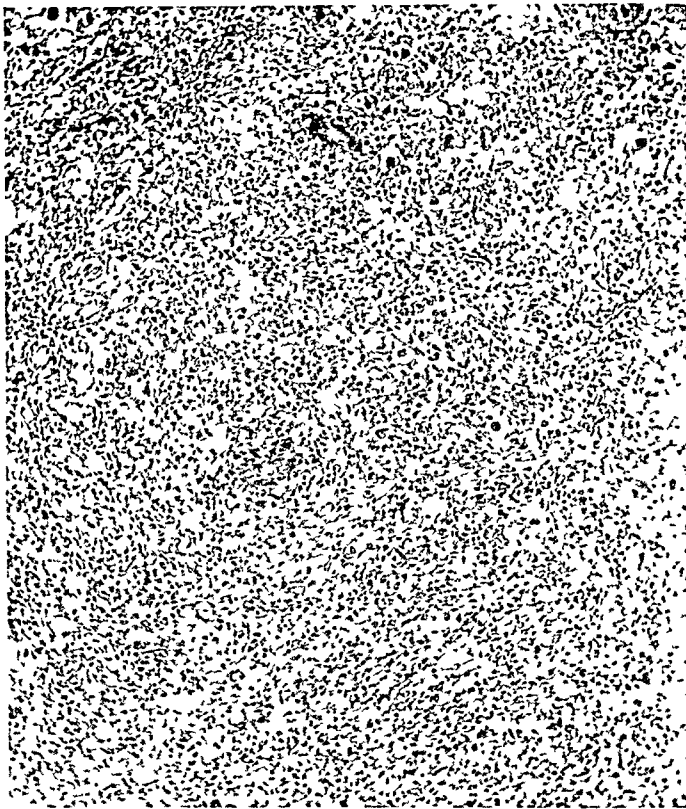


FIG 4 —Plain solid carcinoma The epithelial cells of the follicles advancing with no differentiation of structure. (Photo mic furnished by A C. Broders, Rochester.)

Fig. 5.—Squamous-cell epithelioma of thyroid. Note the large pearl of epithelial cells and below thyroid follicles (Photo mic. furnished by H. E. Eggers, Nebraska University School of Medicine.)

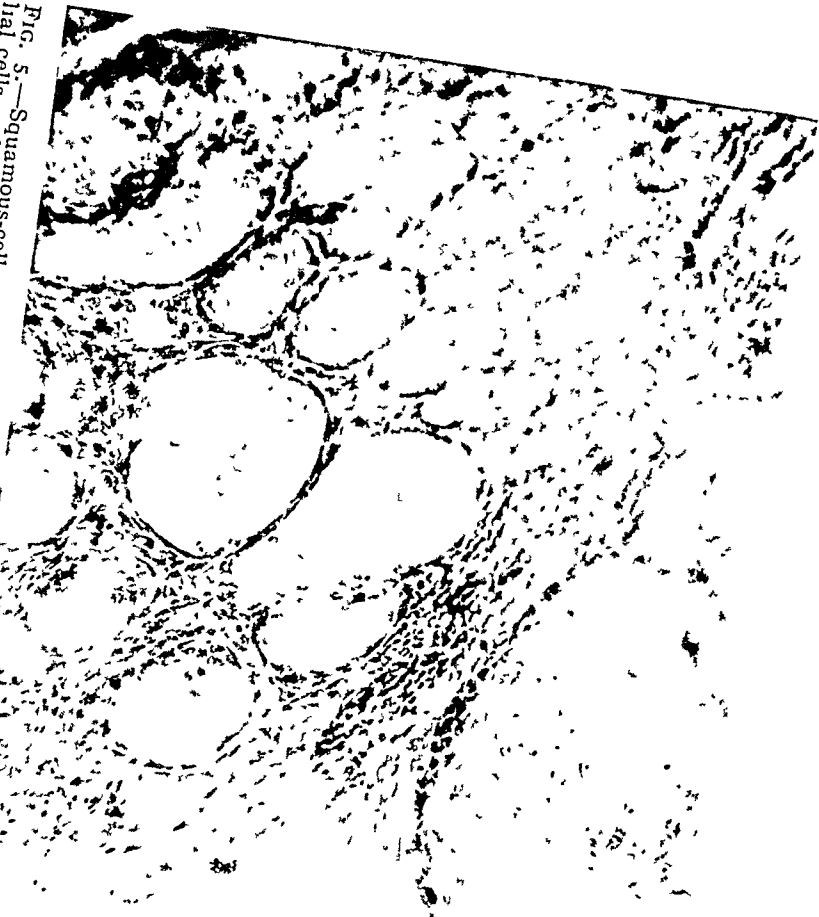


Fig. 6.—Squamous-cell epithelioma of thyroid. Note pearly formations. Specimens adjacent to Fig. 5. (Photo mic. furnished by A. C. Broders, Rochester.)





FIG. 7.—Atrophic follicles. Showing a specimen adjacent to Figs. 5 and 6 in which only atrophic thyroid follicles are found. (Photo mic. furnished by A. C. Broders, Rochester.)

SQUAMOUS-CELL EPITHELIOMA OF THE THYROID

CASE IX.—MERMET, P., and LACOUR, R.: *Epitheliome tubule du corps thyroïde, propagation laryngo-trachéale*. *Bull. Soc. anat. de Par.*, 1896, lxxi, 791.

Case, female, aged fifty years. "Has had goitre three to four years past, with rapid growth past two months on left side particularly. The tumor was mobile, with the trachea and larynx hard but not tender. No enlarged glands, but a paralysis of the left recurrent laryngeal nerve. Autopsy following operation a few weeks later showed whole gland invaded, also larynx and trachea, with no enlarged glands. Histological report; viz., a tubular pavementous epithelioma of the thyroid type arranged in strands."

DOUBTFUL CASES

CASE X.—DREYER-DUFER: *Epitheliome généralisé du corps thyroïde*. *Bull. Soc. Anat. de Par.*, June, 1893, lxxviii, 410.

Case, male, aged sixty-six years. "Autopsy showed tumor originated from thyroid (did not say which side). Metastasis in liver, lungs, spleen and kidneys. Carcinoma of pylorus with metastasis to local lymph-nodes. Histological examination showed tumor of an epithelial tubular type involving thyroid, tending toward the fetal type of the gland."

NOTE.—Probably an embryonal adeno-carcinoma.

CASE XI.—LE FUR, R.: *Epitheliome du corps thyroïde s'accompagnant de suppurations cervicales*. *Bull. Soc. Anat. de Paris*, 1898, ix, 261.

Case, female, aged fifty-nine years. "Histological examination showed a cylindrical-cell epithelioma."

NOTE.—The author does not give any histological details on which the diagnosis of an epithelioma was based, nor is a prototype suggested. The case is evidently not a true epithelioma.

CASE XII.—DELHERM and LAIGNEL-LAVASTINE: *Epitheliome primitif du corps thyroïde*. *Bull. Soc. Anat. de Par.*, 1902, lxxii, 354.

Case, female, aged forty-three years. "Autopsy showed tumor right lobe thyroid with metastasis to lungs and pleura. Left lobe normal. Histological examination showed tumor to be a cylindrical-cell epithelioma developed at the expense of the covering (revêtement) cells of the follicles of the thyroid."

NOTE.—This description suggests a basal-cell type. I am not sure what cells he refers to as the covering (revêtement) cells of the follicles.

CASE XIII.—BARBET, P.: *Epitheliome du corps thyroïde avec métastases osseuses dans le sternum et dans une pseudarthrose du fémur*. *Bull. Soc. Anat. de Par.*, 1910, lxxxv, 233.

Case, female, aged sixty-five years. "A malignant tumor arising from the right lobe of the thyroid had extended beneath the sternum. Histology of one of the bosselated nodules of the thyroid showed the structure of thyroid with a covering layer of cubic epithelial cells and filled with colloid substance. The epithelium had proliferated."

CASE XIV.—MARTIN-DURR: *Epithelioma du corps thyroïde; métastase dans les plevres et dans les deux humerus qui sont fracturés spontanément; corps fibreux de l'utérus*. *Bull. Soc. d'anat.*, 1894, lxix, 240.

Case, female, aged fifty-two years. "Autopsy: Soft thyroid tumor easily separated from surrounding tissue and when incised showed marked vascularity. Metastasis to lungs and pleura. Histological examination showed an epithelioma of the thyroid with small colloid cysts similar to physiological points of colloid degeneration of the gland."

NOTE.—The type of malignancy is not stated, and the author does not consider it rare.

CASE XV.—BRAUN, H.: *Beiträge zur Kenntniss der struma maligna*. *Arch. f. klin. Chir.*, 1882-83, xxviii (Case 3), pp. 303-305.

Case, male, aged forty years. "Autopsy found mucosa of œsophagus ulcerated and infiltrated with the same type of malignancy in the thyroid; viz., epithelioma, but the primary growth could not be determined. The cervical lymph-glands were enlarged with changes in liver, kidneys and intestine."

NOTE.—This case is doubtful, the tumor more likely developed from the œsophagus, as œsophageal epitheliomas are much more frequent. Metastases were not mentioned.

CASE XVI.—CORNIL: *Epithelioma du corps thyroïde*. *Compt. Rend. Soc. de Biol.* Paris, 1875, xxvii, 273.

Case, male, aged seventy-three years. "Autopsy showed greatly enlarged thyroid with a malignant tumor in the left lobe. There was also involvement of the pharyngeal mucosa evidently from the thyroid. No enlarged glands."

NOTE.—The author states that the tumor resembled neither true epithelioma nor carcinoma, and that no pavement epithelium is present.

CASE XVII.—HERRENSCHMIDT, A.: *Carcinome pavimenteux du corps thyroïde*. These. Paris, 1904.

Case, male, aged sixty years. "Autopsy showed tumor of thyroid in right side adhered to trachea and œsophagus, with a second mass involving lymph-nodes lying above the pericardium. Histological examination showed carcinoma involving the right lobe of the gland with metastases to lymph-nodes surrounding the trachea and anterior mediastinal nodes. The tumor resembled a transition baso-cellular carcinoma (parakeratotic), possibly due to a branchial inclusion."

NOTE.—It can be ruled out as not being a squamous epithelioma, although probably of branchial origin (endodermic).

CASE XVIII.—*Ibid.*—Case, female, aged forty-one years. "Autopsy showed tumor all through, but mostly in right lobe of gland. Histological report showed a solid carcinoma of a baso-cellular transition type, no doubt originating from the thyroid follicles."

AUTHOR'S CASE

Female, aged sixty-two years. Married, three children. History of attacks of sore throat for many years; has had a uterine fibroid, size of a nine months' pregnancy, for twenty years. Noticed a small nodular goitre for over forty years which had caused no apparent symptoms. For about six months before being seen had noticed a gradual increasing mechanical dyspnœa and a small mass gradually increasing in size in the left lobe of the thyroid. During the previous two months severe choking spells occurred requiring sedatives. During the past few months there has been a dull aching sensation just beneath the upper end of the sternum, and a skiagram showed a substernal adenoma about two inches in diameter with the remaining thorax negative. The patient had been unable to lie flat during the past five months and at the time of the examination had to remain almost constantly in a sitting posture, and reclining occasionally on about three pillows. The examination found a patient under difficult obstructive dyspnœa, moderate cyanosis, pulse 100, blood-pressure S. 160, D. 70, with a mass in the region of the left lobe of the thyroid about 3 x 3 inches and apparently moderately fixed to the surrounding tissues. It felt hard and not tender, suggesting malignancy. The left lobe extended beneath the sternum, from which arose the substernal thyroid. A laryngoscopic examination found abduction and adduction of the left vocal cord absent, but no encroachment on the lumen of the larynx by any formation.

Owing to the obstructive dyspnœa, the presence of the substernal thyroid

and an absence of a narrowing of the lumen of the larynx; an operation was decided upon to relieve the dyspnoea only, feeling that a cure of a malignant condition, if present, would be hopeless. During the ether anæsthetic patient became intensely cyanotic, requiring a hurried incision, and following the delivery of the substernal adenoma the cyanosis completely disappeared. On attempting to remove the tumor involving the left lobe it was found to be definitely malignant, but all the tissue possible was dissected free from the larynx and the œsophagus. Seventy-five milligrams of radium were placed in the space occupied by the tumor for ten hours. The patient did very well for about ten days, when attacks of dyspnoea set in which were difficult to account for, as the laryngoscope found nothing apparently obstructing the larynx. On the fourteenth day after the operation, following a severe coughing spell, the patient suddenly died. No autopsy could be obtained.

The right lobe of the thyroid contained numerous small degenerated adenomata, which were also present in the left lower lobe. The malignant tumor seemed to have originated in the region of the internal surface of the left upper pole, where the remnant of the thyro-glossal duct is most frequently found. On gross section it was of a pale gray color, hard and contained very few blood-vessels. There was no capsule, but the mass seemed to have advanced uniformly, displacing all tissue as it grew.

The microscope showed a typical stratified squamous-cell epithelioma resembling the same type of growth from the skin (Figs. 5 and 6).

In the ten cases of true epithelioma reported here, including mine, there are a few clinical deductions of interest. The duration of symptoms was short, none over twelve months, and the growth rather rapid. The tumor was found in five on the left side, in two on the right, and in three not stated. Metastases were reported once, a complete autopsy being performed in this case. In the remaining cases, with no metastases stated, complete autopsies were reported in only three. The clinical signs suggested few metastases, and from a study of this series one cannot help but incline toward the view that metastases are unusual. The tumors were all hard, on cross-section bloodless and of a pale yellow or light gray color, and seemed to supplant uniformly all other tissues as they advanced.

BRONCHO-PULMONARY FISTULA

ITS IMPORTANCE AS A FACTOR IN ACUTE AND CHRONIC EMPYEMA

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IN THIS communication the term "broncho-pulmonary fistula" is a general expression for a lesion in which a sinus is present between the bronchial tree and the surface of the skin of the chest. It is used interchangeably with other expressions, *viz.*, bronchial fistula, broncho-pulmonary-pleural fistula, broncho-pulmonary-pleural-cutaneous fistula and broncho-cutaneous fistula. The more definitive terms are used where the text requires it for purposes of clarity.

No military injuries are included; nor lesions due to infection with tuberculosis, actinomycosis, etc.

Under the newer methods of treatment there has been a pronounced improvement in the results obtained with operations for empyema. These methods are based upon the more accurate conception of the underlying pathology; upon a more precise knowledge of the proper time at which to operate; upon the realization that the simplest operative procedure is usually the best; upon the greatest care and attention to detail in the after-treatment; and upon the use of the Carrel-Dakin method of chemical sterilization in appropriate cases.

Less frequently than heretofore the sinus in the chest wall fails to close within a reasonable length of time. Our studies have shown us very definitely that when an empyema fails to heal within this time some very determinate factor is present which prevents the healing and obliteration of the cavity. Difficulties arise with the interpretation of the phrase "reasonable time"; for a length of time which seems unreasonable to one is regarded with indifference by another. My own experience has led me to the opinion that in any case a "reasonable" length of time ought to be a very long time indeed, and I am accustomed to wait this very long time and to give the wound every chance in the world to heal spontaneously, especially when I have made sure that drainage is perfect and no unsurmountable obstacle to the cicatrization of the wound is present. I was very much influenced towards this opinion by the manner in which the wound healing took place in the following case:

A middle-aged man was operated upon by rib resection for a post-pneumonic empyema; the sinus persisted for fifteen months, at the end of which time I saw the man for the first time. A small opening was present in the chest wall which discharged some foul pus; the Röntgen-ray showed a homogeneous shadow covering the

whole of the involved side. A radical operation having been determined upon, the chest was opened widely through an intercostal space and the incision was prolonged upwards, posteriorly, parallel to the spine with division of the ribs (Torek). An enormous cavity was disclosed reaching from the very top to the very bottom of the thorax and fully as wide as the depth of the chest. Owing to the presence of a large amount of very foul pus the intention to proceed with an extensive thoracoplasty (Schede) was temporarily abandoned until the suppuration could be controlled and the granulating membrane partially sterilized. The wound was left wide open and was dressed according to the Carrel-Dakin technic. At the end of six months the outer wound had contracted and closed down to a very narrow slit. I had hoped from the way the wound had been healing that any further operation would be unnecessary; but at that time six months seemed "unreasonably" long and I determined to proceed with my original intention. On reopening the wound I was astounded to see that the original huge cavity had contracted down to a narrow gutter barely a finger's breadth in width. I am quite sure that if I had waited but a little while longer, the entire wound would have closed spontaneously.*

There are a number of factors which can interfere with the closure of the thoracic sinus after operation for empyema. Practically all of these functionate by constantly reinfecting the cavity which is to cicatrize, and many of them are those which interfere with the proper sterilization of the wound with Dakin's solution. All of these may be roughly grouped into (1) those in which there is insufficient drainage at the external opening; (2) those with inadequate drainage due to the complicated structure of the empyema cavity (subsidiary loculi, etc.); (3) those with persistent foci of infection in the periphery of the empyema cavity (osteomyelitis of the ribs, etc.); (4) foreign bodies; (5) communicating broncho-pulmonary fistulæ. Over some of these we have almost perfect control, as, for example, a badly carried-out drainage or an osteomyelitis of the rib. Over others we have only partial control; such would be the empyemata which are not simple cavities, but in which the main cavity is complicated with subsidiary loculi; the drainage of the latter is at best imperfect.

In previous years much has been said about rigid cavities as efficient causes for the failure of closure of the thoracic sinuses. I do not believe, however, that the rigidity of the empyema walls—and here, of course, I speak of the visceral layer—is a primary phenomenon. I have the impression that it is distinctly a secondary process owing its presence to any one of the causes mentioned in this communication, which functionate as impediments to the healing by constantly reinfecting the cavity. The constant reinfection is conducive to an overproduction of scar tissue in the granulation membrane lining the cavity, and the superabundance, by its very massiveness, lends the unyielding qualities to the visceral sur-

* Private records.

face. A vicious circle is thus formed, so that frequently a pneumolysis of some sort is necessary to permit, or aid in permitting more rapidly, the expansion of the lung. But in very many cases the efficient removal, operative or otherwise, of the essential primary cause is followed by a progressive yielding of the membrane and an obliteration of the cavity. It is significant that with increased knowledge, much less has been said in the last few years of rigid cavities as causes for chronic empyema sinuses.

The more I see of empyemata the more I am convinced that the greatest obstacle to healing is the presence of a broncho-pulmonary fistula; over this impediment we have no control at all. The fistula may be so small as to readily escape demonstration. I feel sure that broncho-pulmonary fistula is a very frequent complication of empyema even in cases in which no disturbance in the healing is apparent and in which there is no inkling of its presence. This should not appear extraordinary, since the opinion is gaining ground that many, if not all, of the empyemata complicating pneumonia result from the superficial abscesses (Rosenbach¹) which rupture into the pleural cavity. The importance of broncho-pulmonary fistula in causing chronic sinuses seems to be corroborated by the further observation that the largest number of chronic sinuses follow the meta- or post-pneumonic type of empyema. It seems that as a cause for chronic empyema sinus broncho-pulmonary fistula holds first place.

The subject of broncho-pulmonary fistula has up to the present not received the careful attention which it deserves. As one looks at the problem of empyema one cannot help but realize that in the vast majority of the cases the suppurative pleurisy is but a complicating condition secondary to a similar pyogenic process in its immediate environment—most often the lung.² There are other originating foci, notably those underneath the diaphragm. Those empyemata which occur as incidents in the course of bacteriæmias of one kind or another can be grouped with the lung-empyema cases, inasmuch as it seems from what we know that the mechanism must necessarily include an intermediate embolic lesion appearing near the surface of the lung which in turn gives rise to the empyema in a manner similar to that to be described. In actual practice, therefore, the lung-empyema cases form well over 85 per cent. of all cases of empyema. I think that an indeterminate number of the cases classified as "primary empyemata" (the latter about 11 per cent. in number) must also be secondary to some superficial pulmonary lesion, any and all evidence of which is not demonstrable during life, at operation, or in the fatal cases, at post-mortem examinations. The absence of this evidence is the reason for classifying these cases as "primary."

The primary lesions in the lung are essentially either pneumonic areas, either of the lobar or lobular type, or frank abscess formations. Combinations of the two also occur; the sequence begins in a pneumonia and ends in the liquefaction of the consolidated tissue and its conversion into a

suppurating focus. Rosenbach¹ was the first to suggest the probability that many of the meta- and post-pneumonic empyemata are directly induced by the rupture into the pleural cavity of small superficially placed abscesses resulting from similar foci of liquefaction in consolidated portions of the lung. What evidence we have seems increasingly to show that this mechanism is perhaps the most common—if not the only one—by which the ordinary forms of meta- and post-pneumonic empyemata make their appearance. In a number of instances I have been able to demonstrate these abscesses on the operating table. The observation of Rosenbach is also corroborated in the report of the Empyema Commission;³ in the cases which occurred at the camps during the epidemic small abscesses, which often were multiple, were repeatedly found at autopsy in the superficial parts of the lung directly under the visceral pleura.

With the meta- and post-pneumonic empyemata the disturbance created by the production of the empyema is commonly at a minimum. The very nature of the process lends every assistance to this state of affairs. Commonly there is a pleurisy over the involved area and adhesions are the rule; the progression of the lesion is comparatively slow; the rupture takes place concomitantly with its efficient localization by adhesions; the static conditions within the thorax are not disturbed. The communication with the interior of the pulmonary parenchyma is comparatively small and is further rendered futile—very often only temporarily, however—by the pneumonic exudate surrounding and plugging it, thus effectually blocking any immediate free communication with a bronchus of any size. I have appreciated this latter fact very forcibly on many occasions. A patient would be operated upon for empyema and, apparently, the latter was one with no broncho-pulmonary communication. As the case was subsequently watched one distinguished that the primary pneumonia was being overcome. Then the presence of the broncho-pulmonary communication would be more or less suddenly discovered, frequently by the “gassing” of the patient during an irrigation of the sinus with Dakin’s solution—this when previous irrigations had given no discomfort of any kind. Undoubtedly the complete resorption of the pulmonic exudate had much to do with the “opening up” of the broncho-pulmonary fistula.

With frank lung abscesses the picture is different, depending on the acuteness or chronicity of the suppurating focus. In the former of these two there is a comparatively acute abscess formation, probably of embolic origin, with soft, non-demarcating walls, frequently multiple, commonly with few or no physical signs, and very apt to cause perforations between the non-adherent visceral and parietal pleuræ. The latter accident becomes associated with a sudden increase in the severity of the symptoms and the clinical picture becomes associated with and characterized by high fever, marked dyspnoea and cyanosis, and other signs of a high

grade of intoxication; the picture is that of an hyperacute pneumothorax. Pathologically these abscesses are noted by the absence of surrounding areas of induration. The resulting empyema involves, practically, the entire pleural cavity; the exudate is distinctly purulent—rather thin and frequently sanious—very foul and very toxic. As far as I know almost every case of this kind goes on to a fatal termination.

The second variety includes the chronic lung abscesses. The most characteristic of these are the foreign-body intrapulmonary suppurations which follow aspiration of a fragment of tonsillar tissue during a tonsillectomy. Anatomically the lesion consists of a central cavity containing foul-smelling, brownish-red, grumous pus in which a multitude of aërobic and, especially, anaërobic organisms flourish; a limiting granulation membrane of firm consistence; and a wide surrounding area of induration merging into pulmonary tissue in which fibrosis, secondary bronchiectatic dilatation and atrophy predominate. The lesion may be single or multiple, and with it an advanced grade of suppurative bronchitis is associated. An adhesive pleuritis is almost the rule and is usually limited to the area of lung involvement. The process begins in obstruction of the bronchus with secondary infection. Of necessity from the very beginning a communication is present with a fairly large size bronchus; more or less free drainage of the abscess is constantly present into the bronchial tree; perforation through the visceral surface into the pleura is uncommon. Empyema is, therefore, likewise uncommon; a general empyema is rare and occurs in those very exceptional cases in which no pleural adhesions have formed. The empyemata which are found are comparatively small and localized, and the mechanism of their production becomes apparent from the anatomical structure in which one wall of the empyema cavity is formed by a much thickened parietal pleura and the opposing wall by suppurating membrane based on pulmonary parenchyma (pleural vomica). Bronchial fistulæ are always present. Clinically the pathology is characterized by a prolonged period of illness, by a distressing cough, by fetid and profuse purulent sputum, by the evidences of progressive general deterioration and of local pulmonary involvement, and by characteristically definite röntgenographic pictures; the general character of the entire complex is largely determined by the presence of the bronchial fistulæ.

This type of empyema complicated by bronchial fistulæ is illustrated by the notes of the following case:

In a man, aged fifty years, a lobectomy was done for a "chronic lung abscess." The description of the pathology as demonstrated at operation and by a study of the removed specimen is as follows: The lesion was present in the lower right lobe. The anterior, mesial and diaphragmatic surfaces of the lobe are free from adhesions. The latter are, however, present at the postero-internal border of the lung as far forward as the ligamentum latum pul-

BRONCHO-PULMONARY FISTULA

monum and for the entire extent of the latter from the pulmonary hilum to the base. In this location there is an empyema cavity containing several ounces of thick, yellow pus. The mesial wall of the abscess is a much-thickened parietal pleura lining the reëntrant angle formed by the bend of the ribs and the posterior mediastinum; the outer wall is pulmonary parenchyma, without vestige of visceral pleura, and in which the open ends of a number of bronchi of the second and third order are distinctly visible. The empyema lay for the most part within pulmonary parenchyma and really constituted the major part of the lung abscess.*

The observations in regard to the mechanism by which lung lesions (pneumonia and lung abscess) are complicated by empyema is most important, inasmuch as it teaches that in the commonest varieties of empyema the latter occurs ordinarily only in the presence of a destructive lesion in the pulmonary parenchyma the progression of which involves the pleura by perforation. As far as the empyema is concerned there is no essential difference in the mechanism whether the primary lesion is a pneumonia or whether it be a lung abscess; the important point to remember is that in either case there is necessarily present a communication with the interior of the lung or bronchi or both. The difference, if any, is one of degree of virulence and toxicity of the offending organism; of the rapidity with which the process advances, with which the lung tissue is destroyed, with which the perforation takes place. The result varies with the presence, or absence, of pleuritic adhesions in the neighborhood of the pulmonary process; with the size of the perforation and its communicability with one of the larger bronchi. The size of the latter has mathematical relationships with the character of the initial pneumothorax, with the resultant disturbances of the static and dynamic conditions within the thorax and with the severity of the clinical manifestations which are presented. The whole picture is built around the presence of a broncho-pulmonary communication.

The demonstration of a bronchial fistula furnishes indubitable evidence of the presence of a suppurative process in the midst of the lung tissue. In the great majority of the cases the presence of the fistula is to be interpreted as proof of the priority of the pulmonary process to which the empyema is subsidiary. In the lung-abscess-empyema cases the communication is frequently multiple and is usually direct and extends almost always into one or more fair-sized bronchi of the second or third order; the usually profuse and foul sputum, present before operation, resembles in all particulars the pus of the abscess and of the empyema; but it immediately disappears following the adequate drainage of the empyema and of the pulmonary focus and reappears directly *drainage is interfered with* from any accidental or purposeful cause. Healing is tedious and prolonged and most often the bronchial fistula is

* Private records.

an insurmountable obstacle to the closure of the chest wall sinus until, and perhaps even after, a radical operation is done. In those empyema cases which are subsidiary to small superficial pneumonic abscesses (Rosenbach¹) that rupture into the pleura, a communication with the bronchial tree is not always demonstrable, even though they are undoubtedly present; in much the smallest number a communication makes itself apparent when, for one or another reason, a fluid irritating to the respiratory tract (Dakin's solution) is introduced into the empyema cavity. The fistula may be tortuous and is narrow and communicates usually with one of the smallest size or terminal bronchi. The amount of infiltration around the sinus tract is at a minimum and the tissues are soft and pliable and have a tendency to fall together; facilities for healing are most favorable in these cases. It is the rule for these communications to heal spontaneously and close very quickly, and it is exceptional for them to cause any extraordinary prolongation of the cicatrization of the wound. Characteristically the amount and physical appearances of the sputum is independent of the contents of the empyema cavity, has no resemblances to the wound discharges, and depends for its production on any associated bronchitis which may be present or upon the liquefaction of the pneumonic exudate which had antedated the empyema.

In only a minority of the cases of empyema complicated with bronchial fistula is the evidence sufficient to indicate that the communicating sinus has resulted from the rupture of the empyema into some part of the bronchial tree. Such, for instance, would be so when an unrecognized liver abscess perforates through the diaphragm and discharges through a bronchus after having first created a subsidiary abscess in the intrapleural space; these occurrences, while quite well known, are relatively infrequent. With simple empyemata the discharge of pus into the respiratory tract is extremely rare; and probably when such an accident happens it indicates the rupture of a coëxisting and perhaps unrecognized pulmonary focus. The experiences which I have had seem to show that the intrapleural abscess discharges much sooner on the skin (empyema necessitatis), or remains, practically in an unchanged state except for the progressive thickening and even calcification of the limiting membrane.

It is a different matter with the frank lung abscesses; free communication with the bronchial tree is almost the rule with partial or complete drainage of the pus in the sputum.

In the cases in which the broncho-pulmonary fistula fails to close spontaneously—and in the total number of empyema cases, these, as indicated previously, are very few—the structure of the fistulous tract and its relations to the sinus in the chest wall, the empyema cavity, and the interior of the pulmonary parenchyma depend upon the character of the initial pathology, the size of the bronchial communication, the structural characteristics of the empyema cavity and the amount and character of the healing which has preceded at the time the fistula is recognized.

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Much of this has been alluded to and explained in the parts of this communication dealing with the primary foci causing the empyema. As one sees these cases in actual practice one of a number of conditions is present.

In some of the cases—and I have the impression that these comprise the least number—the healing of the empyema has proceeded to that point at which the entire cavity has become obliterated and a narrow sinus is present which admits the passage of a probe within the chest to an alarming depth, evidently well within the interior of the pulmonary parenchyma. The bronchial communication is readily recognized by the expiratory and inspiratory current of air passing to and fro through the fistula. If the latter be sufficiently large efficient respiration can be carried on through the opening in the chest wall, even when the mouth and nose are occluded. The boundaries of the sinus (Fig. 1) include (a) the entire thickness of the chest wall, (b) the thickened pleuræ, and always (c) in the cases which I have examined some extent of pulmonary parenchyma. The wall of the sinus is lined with granulation tissue from which a certain amount of purulent discharge is constantly forthcoming. With the usual narrow sinus the quantity of discharge is limited and small; but I have frequently noted, first, that as the acute inflammatory condition in the bronchial tree subsides this quantity diminishes and, secondly, if a new attack of bronchitis supervenes, as it so often does, the discharge from the sinus increases at a proportionate rate with the production of sputum and resembles the latter in all particulars. The constant presence of a low grade of inflammation in the bronchial tree with the superimposition of repeated attacks of acute inflammation, which is aided materially by any associated localized or general bronchiectasis, furnishes one of the most important causes* for the constant reinfection of the fistulous tract and for its consequent refusal to heal.

In other cases an appreciable cavity is present. This may be comparatively small (Fig. 2); or it may be as large as almost the entire interior of one side of the chest (Fig. 3). There may be a single broncho-pulmonary communication (Fig. 2) or the latter may be multiple (Fig. 4). In one case, which I saw, there were several well-demarcated loculi in two of which broncho-pulmonary communications could be demonstrated (Fig. 4). The relationship of the part of the fistula lying within the lung tissue and the external opening in the chest wall is variable; frequently the former is at some inaccessible location on the visceral wall of the empyema. The proportion of discharge escaping from the opening in the thoracic wall which is derived from the pulmonary part of the fistula is not determinable, inasmuch as it is lost in the total much larger discharge derived from and escaping from the empyema cavity; and I

* Tuffier⁴ speaks of necrotic bronchial cartilages as efficient causes for the persistence of the bronchial fistulæ. In my own experience I have never seen this lesion in any civil case either during life or post mortem. I have the impression that Tuffier derives this observation from his military experiences.

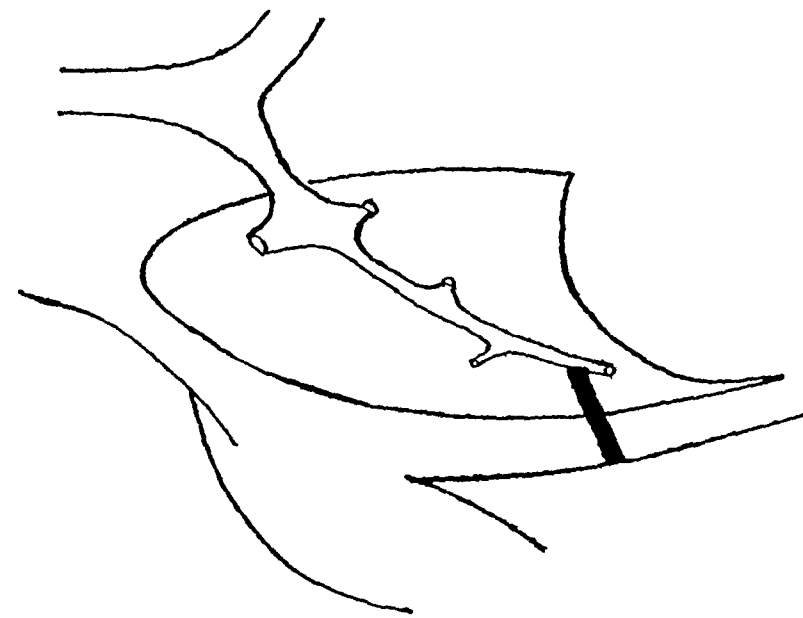


FIG. 1.

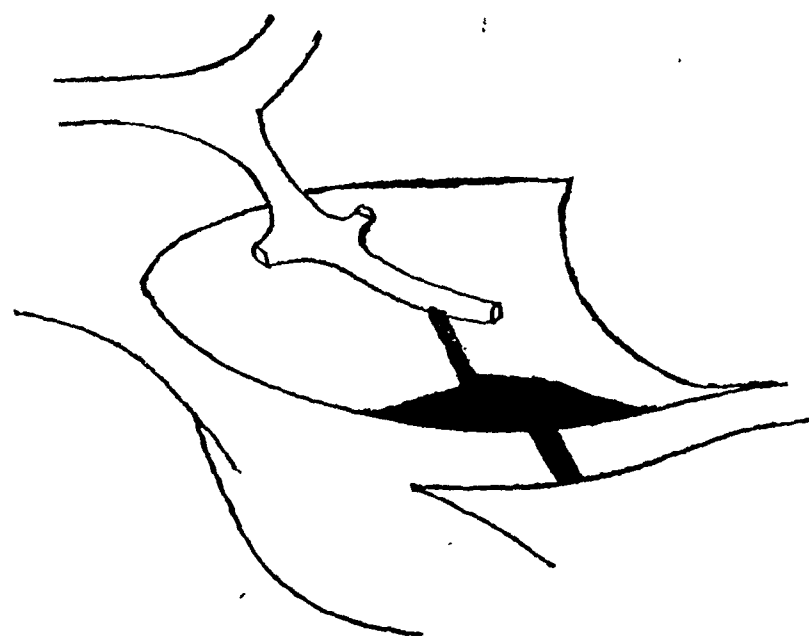


FIG. 2.



FIG. 3.

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therefore have never been able to observe in these cases any increase in the discharge accompanying a recrudescence of, or any new inflammatory lesion in, the bronchi.

In any of the cases the continuity of that part of the fistulous tract lying within lung tissue is frequently broken by the intermediation of a larger or smaller pulmonary abscess. In conformity with the previously described pathology the latter may lie near the surface of the visceral pleura, deeper in the parenchyma, or closer to one of the large bronchi (Figs. 5, 6 and 7). Under these conditions it is more than probable that the perforation into the bronchus occurs in the largest number of the cases at some period subsequent to the perforation into the pleura and is due to a progression of the suppurative lung focus in its effort to secure more and efficient adequate drainage denied to it for various reasons (smallness of the opening, inaccessibility, etc.) at the opening in the visceral surface of the lung. Constant retention of pus within such structures is quite common and accounts, I feel quite sure, for many of the unexplained cases of fever developing during the course of the convalescence and during the healing of the empyema sinus. For similar reasons healing of the pulmonary abscess is very frequently impossible, and its persistence is the dominant cause for the constant reinfection of the entire fistulous tract including the empyema cavity and for an almost unlimited continuance of the latter.

In all of the cases which I have so far considered the sinus runs through a considerable depth of tissue. Even in the most favorable cases, in which the sinus is extremely narrow and straight (Fig. 1) and in which the bronchial opening is as near to the visceral surface of the lung as it is possible to be, the depth of tissue includes necessarily the thickness of the chest wall and a certain extent of lung tissue and is, especially in adults, at least three inches long. In the cases in which an empyema cavity is present the latter ought properly to be considered as forming an integral part of the complete fistulous tract (Fig. 2); of the latter the empyema is a ballooned-out portion. Similar consideration should be given to any coëxisting lung abscess (Figs. 5, 6 and 7). I make this point advisedly because one can readily see how futile it would be to do anything to the empyema alone (*i.e.*, one part of the complete fistulous tract) if the remaining portion of the fistula is not recognized and corrected.

One of the reasons very frequently given for the persistence of the fistula is that the skin epithelium, on the one hand, and the bronchial epithelium, on the other, grow inwards and outwards in the fistulous tract until, having met at a common point, the entire tract becomes epithelialized (broncho-cutaneous fistulæ). To be sure, the consummation of this process would make an insurmountable obstacle to any natural healing. I believe, however, that this is a very rare occurrence, and never in my experience have I been able to demonstrate this either to the naked eye or in microscopical section in any case operated upon with any minor pro-

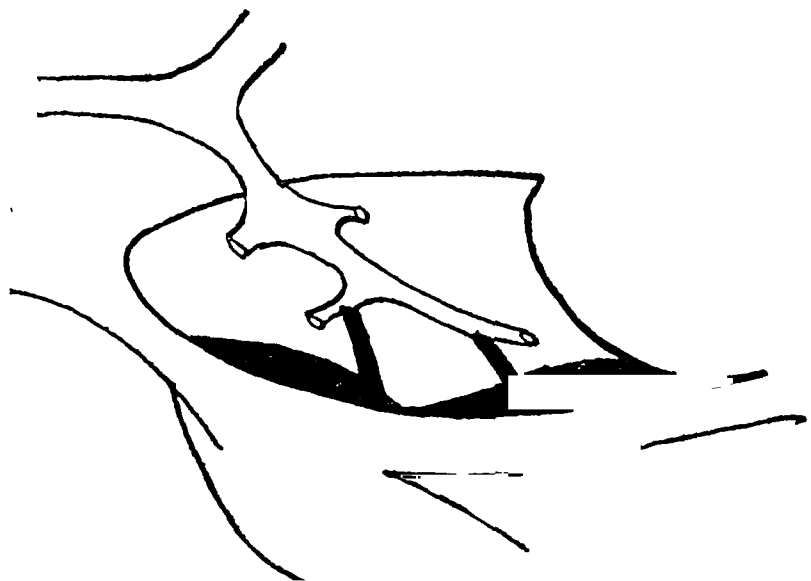


FIG. 4.

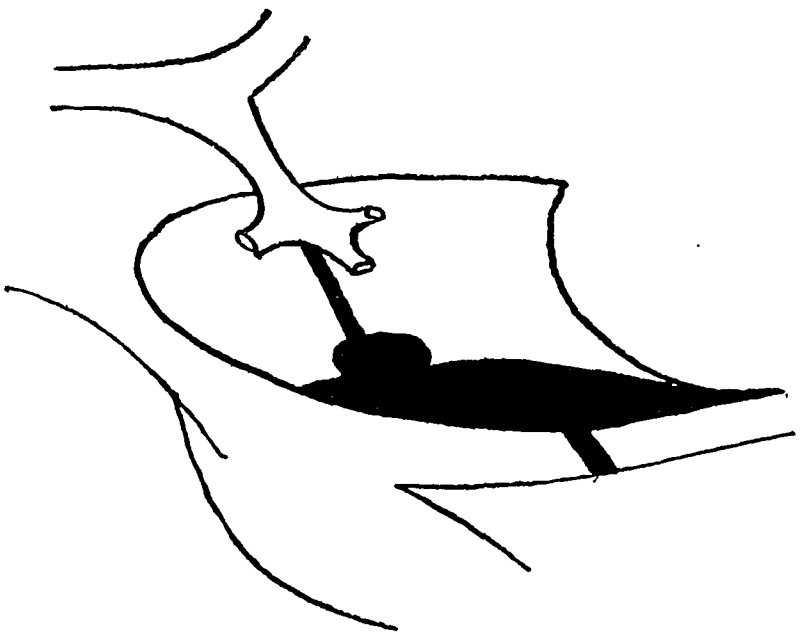


FIG. 5.



FIG. 6.

cedure such as an intercostal incision or simple rib resection. I have seen this attempted and more or less completed epithelialization of a fistulous tract after extensive operations have been performed on the chest wall of which the object is the collapsing and healing of empyema cavities. In some of these cases the resultant wound is very large—frequently this is purposely made very large so that skin flaps can be swung into place to aid the cicatrization—and an enormously long and wide shallow gutter results. Then with or without the aid of skin grafts, or pediculated skin flaps, the epithelialization of the floor of this gutter, which is really visceral pleura, goes slowly on until the previously recognized or newly discovered bronchial fistula is reached. There it apparently stops but, in reality, becomes continuous with the bronchial epithelium, and when no inflammatory process of any kind is present in the bronchial tree, none or a very insignificant amount of discharge escapes from the broncho-cutaneous fistula and the patient continues so for an unlimited period of time in comparative comfort.

Given the establishment of any of the varieties of broncho-pulmonary-pleural-cutaneous fistulæ described in this communication the dynamics of the resultant intrathoracic conditions are such as are most conducive to its unrestricted persistence. It is certain that the most important reason for the obliteration of any empyema cavity is the constant exertion of a distending force produced by the inspiratory dilatation of the pulmonary parenchyma. If, for any reason, this is interfered with, a most efficient factor in the healing is destroyed. There are two ways in which this interference can occur:

1. The visceral wall of any empyema is an elastic membrane, and being the only movable part of the bounding walls of the cavity its gradual protrusion outwards towards the bony wall of the thorax is the only method by which healing finally takes place. In the ordinarily operated and drained cases the mechanical conditions are those illustrated in Fig. 8. The distending force working to obliterate the cavity *E* is the column of air entering the appropriate lung through its main bronchus *D*. In the presence of an opening in the chest wall a column of air is also simultaneously sucked into the empyema cavity at *C* and an additional opposing force is thus created tending to neutralize the distending power of the column entering at *D*. The constant factors in either force are the sucking power of the thorax and the atmospheric pressure; the variable factor is the difference in the size of the openings through which these forces work, namely, the diameter of the bronchus at *D* and of the chest opening at *C*. If the opening *C* is equal to or larger than that of the main bronchus at *D*, the opposing force to the latter is either equal to or larger than the distending force, the latter is neutralized, and no appreciable effect can be exerted on the visceral pleural membrane towards the distention of the lung and the obliteration of the cavity. In order to have the lung

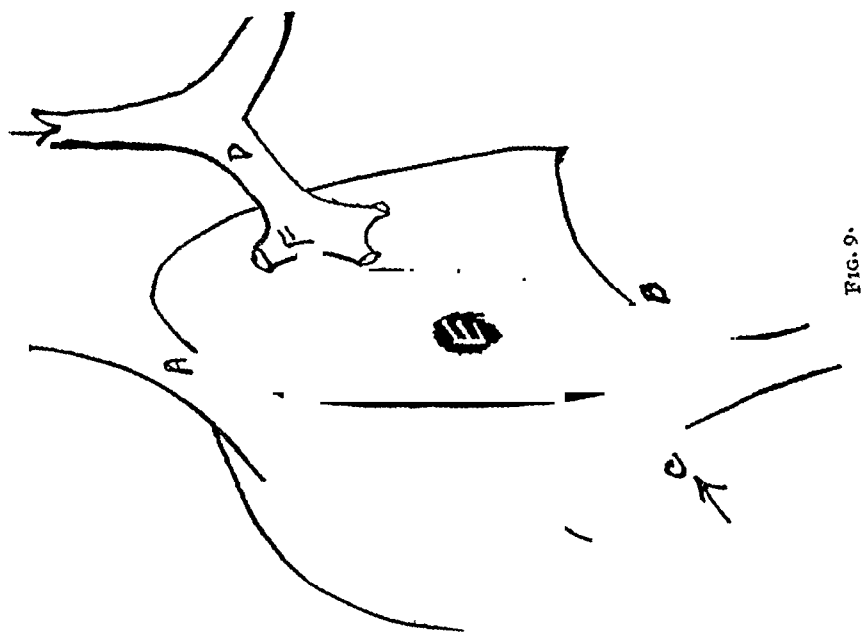


FIG. 9.

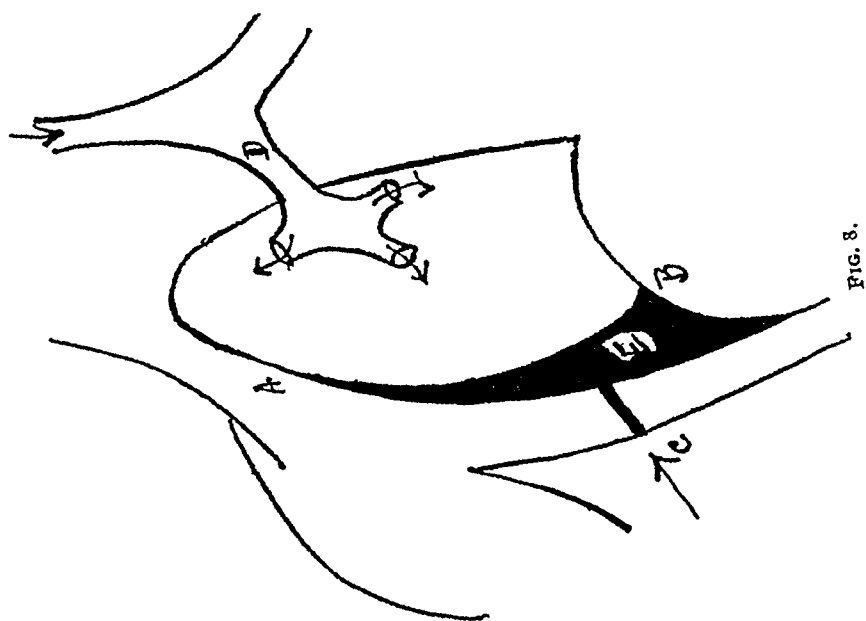


FIG. 8.



FIG. 7.

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properly distended the calibre of the opening in the chest wall must be smaller than that of the main bronchus.

2. Even when the mechanical conditions indicated in the previous paragraph are as they should be, the 'distending effect of the inspiratory force can be completely nullified by the presence of a bronchial fistula. This is readily seen in Fig. 9: the column of air entering at *D* cannot possibly attain any efficient pressure because most of the latter is dissipated by the escape of air into the empyema cavity through the sinus at *F* (compare with attempts to blow up an automobile tire in the presence of a hole in the fabric). This is not only bad enough; it is rendered much worse because that part of the inspired air blowing through the broncho-pulmonary-pleural portion of the fistulous tract into the empyema cavity at *F* combines forces with that entering through the chest wall opening at *C*, and, instead of distention of the lung parenchyma, compression occurs (Fig. 9).

One can readily understand what a vicious circle such a fistulous tract of any kind would produce. The empyema cavity would tend to grow larger instead of smaller, and I have no doubt at all that many of the enormous cavities which one sees from time to time are formed in this way.

Various factors were enumerated in the earlier part of this communication which are capable of preventing the healing of any empyema; fortunately all of these are fairly easily demonstrable with the means at our command. In any individual case constant perseverance is necessary that these complicating factors are not allowed to occur to disturb the normal healing of the empyema; or that having occurred they be recognized and corrected without any undue waste of time.

With the exercise of care the presence of any bronchial communication ought to be recognizable very promptly in the greatest number of the cases. As pointed out previously in this communication, the largest number of the broncho-pulmonary fistulae close spontaneously; and if the recognition of the presence of the latter occurs in the early part of the course of healing of the empyema cavity it may be expected that closure will follow unaided, especially in the varieties of empyema referred to and described previously in this paper. Once, however, such a complete fistula becomes well established it can almost always be taken for granted that little or no advance in the healing of the sinus or broncho-pulmonary-pleural-cutaneous fistula will occur and that some radical operation will be necessary if a cure is to be obtained. Operation is, however, difficult and dangerous and the prospect of success is not always certain.

In those not associated with any bronchitis or other inflammatory lesion in the lungs and in which there is no appreciable empyema cavity but only a narrow sinus the disability produced by the latter is at a minimum, the care of the chest opening is one which the patient himself can exercise and the daily occupations and duties of the latter can be

carried out with no discomfort and with very little risk. To patients of this class, I believe, the actual state of affairs ought to be explained and they should be given an opportunity of choosing between the retention of the sinus with its slight inconvenience and the operation with its attendant dangers. Operation must necessarily include the excision of the entire fistulous tract, the adequate liberation of the affected lobe, or lobes, of the lung through a sufficiently large incision, the closure and inversion of the opening in the bronchus and its further guarding when feasible by some plastic procedure. In any case it is best to wait until the suppuration is at a minimum before undertaking any operation, otherwise retention abscesses occur.

If it can be determined that a lung abscess is also present in addition to the fistula, the closure of the latter might interfere with the drainage of the former and cause an increase in the pulmonary focus. Under these conditions the only operation that suffices is a lobectomy of the involved portion of the lung. It is needless to say that such a procedure is one of great difficulty, one in which there is the maximum danger both immediately and more remotely. The choosing of the proper case for the operation of lobectomy restricts the field markedly; for only with everything in the patient's favor can any success be expected, especially as regards the immediate outcome of the operation. So that in many, operation must be refused and the best be made of a wretched state of affairs. In appropriate cases some of the discomfort can, perhaps, be removed by intrabronchial washings of the abscesses (Yankauer). Even under the best of conditions the expectation of ultimate cure is, however, extremely small.

Just what one must do with the large empyema cavities complicated with bronchial fistulæ of one kind or another is one of the difficulties of surgery. The fistula is not always demonstrable, even on the operating table. In the stubborn cases no one method of operation suffices for all. The two essential methods of attack are directed towards collapsing the chest wall (thoracoplasty), or towards aiding and facilitating the expansion of the lung (pneumolysis)—both of these with the object of securing a rapid cohesion of the large opposing surfaces. The closure of the opening in the bronchial tree and the excision of the pulmonary portion of the sinus tract, when the latter is of considerable length, is itself an undertaking; frequently the success of the larger and more extensive operation, indicated above, is nullified by the failure of that part of the operation directed towards the closure of the fistula. In any case, one should not limit one's self with any preconceived intention of adhering exclusively to any one essential type of operation; I am quite sure that in many of the cases every available type and method of operation (thoracoplasties, pneumolyses, various types of incision, etc.) ought to be considered and utilized in order to insure success.

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OBSERVATIONS ON CHOLELITHIASIS*

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IN looking over a series of the first thirty cases of cholelithiasis that I operated on at Bellevue Hospital (Cornell Division) after our follow-up system was first inaugurated, and ten cases in private practice during the same period, certain interesting facts appear, which hold in a larger series of cases. I have not taken more recent cases as the end-results are not yet shown in the return records. I refer also to other cases in private practice and to a few recent hospital cases.

Of the forty cases 67.5 per cent. were women. The age varied from twenty to sixty-six years, and the age of nearly half was from thirty to thirty-six inclusive, nearly all women, several of whom gave a history of the trouble commencing during pregnancy. The duration of the condition since its apparent onset varied from ten days to fifteen years.

Ninety per cent. had had more or less typical colic, while the symptoms were overshadowed by those of a concomitant duodenal ulcer in one case, and in another the pain was more constant than colicky. This is an unusually large percentage of cases with colic. Of course, it is easier to persuade a patient who has had colic to have an operation, than one who has merely had attacks of indigestion, which is what so many patients complain of in the early period of cholelithiasis. Of the cases with distinct colic, radiation of the pain to the back is noted in 63 per cent., to the back alone in 44.5 per cent., and to the back and right shoulder in 18.5 per cent. In two cases it radiated to the right shoulder alone.

In this series local tenderness over the gall-bladder is noted in 63.3 per cent., over the gall-bladder alone in 53.3 per cent., over the epigastrium also in 10 per cent., while in 10 per cent. there was tenderness over the epigastrium alone. Of course, some of these were operated in the quiescent period, which may account for the absence of marked tenderness in several cases. Incompleteness of the history may also account for the lack of mention of this symptom when present, and this may also account for the percentage of some of the other characteristic features.

Of the gastric symptoms noted, nausea, vomiting, belching, eructations and epigastric distress are the most frequent. One or more of these constitute the ill-defined indigestion, typical of gall-bladder trouble. The test meal is not diagnostic, except that the acid is more likely to be normal or low than to be high. The symptoms occur soon after eating and are not relieved by it. When colics are present the gastric symptoms have but little diagnostic importance, but in the early stages, or before the occurrence of colics, they are very suggestive.

* Read before the New York Surgical Society, October 13, 1920.

OBSERVATIONS ON CHOLELITHIASIS

Jaundice was present at some time in 35 per cent. of the cases, including one who was told that she was somewhat yellow. This is a rather large proportion and shows again that this group represents late, not early, gall-bladder trouble. When we analyze these cases we find that the jaundice was due to stones in the common duct in seven, while in five it was due to a chronic pancreatitis, and in the others the history fails to mention the condition of the pancreas.

Pancreatitis is a complication that in my experience is more common in gall-bladder disease, as well as in duodenal ulcer, than was formerly supposed. This frequency corresponds with Deaver's view, who thinks that it is caused by a lymphatic infection from a primary infection in these two organs. The pancreas was noted as enlarged in 33.3 per cent., and in several the condition is not mentioned in the history.

There were stones in the gall-bladder alone in thirty-two cases, in at least eight of which one or more stones were impacted in the cystic duct. In the remaining cases there were stones in the common duct alone in three cases, including one where the gall-bladder was congenitally absent. In four cases they were present in both common duct and gall-bladder.

Although cases of cholecystitis belong in another group, a condition of cholecystitis was present in most of these cases, as is brought out by the pathological examination as well as by the appearance and condition of the gall-bladder, as disclosed by operation. In two cases the gall-bladder was constricted so as to form an hour-glass gall-bladder. It was thickened and contracted in 36.3 per cent., thickened in 36.3 per cent. more, adherent in 60.6 per cent., and enlarged in 30 per cent.

When the changes in the gall-bladder reach this stage, removal of stones and temporary drainage will not cure the pathological condition. A diseased gall-bladder is left which may be responsible for the formation of fresh calculi, the occurrence of exacerbations of cholecystitis or of chronic indigestion, often qualitative, causing chronic invalidism. In five cases the gall-bladder was whiter or more opaque than normal, and perhaps very slightly thickened, but otherwise normal. Such gall-bladders might perhaps return to a fairly normal condition after cholecystostomy.

The recurrence of gall-stones and of gall-bladder symptoms is illustrated in five cases (12.5 per cent.) which recurred after cholecystostomy, one six years, one eight years, and one nine years before, and one done in Holland fifteen years before. In general, I think that in most of the cases of so-called recurrence the condition is due to stones overlooked at the first operation. I have found these in the gall-bladder and in the common duct. Eisendrath has called attention to the ease of overlooking them in the common duct. In a more recent case at Bellevue the "recurrence" was in the stump of the cystic duct, probably an overlooked stone. In two of the five cases, which recurred after a previous cholecystostomy, there was a fistula into the gall-bladder, in the abdominal scar,

alternately closed and open, ever since the first operation, and I have had other similar cases. In such conditions a stone was evidently overlooked. In these cases when the fistula was closed there was pain or colic.

In other cases, from the length of the interval free of symptoms combined with a personal knowledge of the operation or the operator, it is reasonable to suppose that the gall-stones have formed anew. And why should they not? for in most cases the gall-bladder is left in a condition of chronic inflammation which, with the stagnation of bile, owing to the thickening and adhesions of its walls, furnishes all the conditions which favor their formation. One of the reoperated cases was a patient on whom I did a cholecystostomy in 1911. She was free from all symptoms for seven years, until three months before reoperation. There were five stones in the gall-bladder, which I am quite sure had reformed.

The chronic cholecystitis may of itself give symptoms, when exacerbations occur. Thus one of the reoperated cases was a patient on whom I had done a cholecystostomy many years before. The post-operative period of the first operation was complicated by an acute dilatation of the stomach, but he made a good recovery. At the second operation there were no stones, only a chronically inflamed gall-bladder, which was thickened and adherent, to account for the recent periodic attacks of pain and distress. He has remained entirely free of symptoms for over three years since the second operation.

Some of the operations for the recurrence of gall-stones or gall-bladder symptoms are most difficult and would strongly indicate, as a primary operation, one that would give the most security against recurrence, *i.e.*, cholecystectomy. Let me give some of the details of a very interesting case bearing on this point:

A patient came for the relief of a biliary fistula. For over a year all the bile had come from the fistula, the stools being acholic. He had had a cholecystostomy and then a second operation, an unsuccessful attempt to close the fistula. I made a probable diagnosis of stone in the common duct and this was found and removed, after a difficult dissection. But on introducing the finger up into the hepatic duct a group of stones was felt, lying in an expansion or pocket in or on the liver, beyond a constriction at the surface of the liver. Very possibly the stone in the common duct had come from this source, and perhaps after the cholecystostomy. With some difficulty these stones were removed, after dilating the constriction. A tube was sutured into the hepatic duct, as usual, but the drainage was almost pure blood. This soon clotted and blocked the flow of bile. Jaundice developed and rapidly increased, with rising temperature. The tube was pulled out after Bier suction had been applied in vain. This suction was reapplied at intervals to the sinus left by the tube, without result, and the general condition was becoming critical, the patient being very dopy and the temperature high. But as the blood-

clot filling the bile-ducts contracted, in time a little bile found its way alongside of the clot. This kept increasing until a full flow of bile was established, the jaundice cleared up, the fistula closed, the patient made a good recovery and remained well.

Another distinct advantage in cholecystectomy is the prevention or occasional early removal of carcinoma of the gall-bladder. This is almost always associated with gall-stones and probably depends for its origin on their chronic irritation, and that of the accompanying inflammation. If we remove the gall-bladder after we can diagnose a carcinoma we will very rarely get it in time to cure the patient radically. A further advantage in cholecystectomy is the prevention of a pancreatitis, which may be due to infection from a chronic inflammation of the gall-bladder.

The chief difficulty in recommending cholecystectomy as the routine operation of choice lies in the fact that recurrences after cholecystectomy are more difficult to handle than after cholecystostomy. For one reason we have no gall-bladder for short-circuiting in case of chronic jaundice from stricture, etc., of the common duct. I had two such cases with chronic jaundice when cholecystectomy was first being used as a routine operation in a large variety of gall-bladder cases. This made me quite conservative for a time, for, unless due to an overlooked stone, the operative treatment is difficult. In a recent case operated on twice at another hospital, which entered Bellevue over three years ago with a biliary fistula of long standing, operation showed that the gall-bladder had been removed and that the common duct was not obstructed by stone or a tight stricture, but was largely compressed by scar tissue from without. The duct was liberated by dissecting away scar tissue, as the conditions were very unfavorable for an anastomosis, but it was doubted whether a permanent result would be obtained. He left the hospital with a biliary fistula, but fortunately this closed the next day and has remained closed since.

I have recently operated for stones in the common duct where a cholecystectomy had been done in another hospital eighteen months before. On account of the symptoms in the interval I feel sure that these stones had been overlooked at the first operation. How easy it is for particles to be left in the common duct which may form the nucleus for recurrent stones, is illustrated in a still more recent case where a large stone in the duct was so crumbling that it broke into fragments and had to be removed by a scoop introduced many times in both directions. After this sterile water was forcibly injected to bring away any particles left behind.

In spite of the fact that the finger introduced into the duct in both directions failed to feel any more particles, a small fragment was later evacuated through the tube.

However, when the gall-bladder has been chronically infected and

its walls altered by inflammatory thickening, it can no longer functionate normally and recurrence of trouble is quite likely. Hence cholecystectomy as a routine procedure, unless there are contraindications, is the safest operation for the future well-being of the patient.

In only two of this series (5 per cent.) was cholecystostomy done and one of these was the only fatal case. The patient was in such poor condition that local anæsthesia was used and the empyematous gall-bladder merely opened and drained of its putrid contents, and a tube sutured into it. After slight improvement another operation was done a month later, again under local anæsthesia. Using a transverse incision, a single stone, wedged into the neck of the gall-bladder and only partly obstructing it, was removed, but the patient shortly succumbed to the cholangitis. This patient had been operated on by cholecystostomy in another hospital nine years before and when she entered Bellevue she was deeply jaundiced and had Charcot's syndrome of chills and fever. With the drainage the jaundice subsided but never entirely disappeared, for, owing to the stone, the drainage of bile was at times insufficient, and at such times she became worse. The head of the pancreas was much enlarged and indurated. A primary cholecystectomy would have avoided all this. In the other case the patient took anæsthesia so badly that a cholecystostomy was done on account of the technical difficulties.

Of course we can lay down no hard and fast rule. The mechanical difficulties as well as the condition of the patient may make cholecystostomy the safer and wiser operation, as in these two cases. With these reservations we now make cholecystectomy the normal procedure in cholelithiasis. It may often be wiser for an inexperienced operator to do a cholecystostomy.

I have seen no particular effect of cholecystectomy unless in two cases a subsequent chronic looseness of the bowels was due to it, attributable perhaps to the more steady discharge of bile into the bowel. It had not been present before.

Mention was made above of a case of congenital absence of the gall-bladder. The fissure of the gall-bladder was present with a smooth surface, save for a few shallow longitudinal fissures. There was no gall-bladder beneath the left lobe and none could be felt within the substance of the liver ("intrahepatic gall-bladder"). Finally, after a careful search, no trace of a cystic duct was found. There were three facettèd stones in the common duct, which was opened and drained. The duct was not dilated any more than it would be from the presence of stones. A. Schachner¹ has collected cases of abnormalities of the gall-bladder and gives seven cases of congenital absence.

In two recent cases the gall-bladder was firmly adherent to the first portion of the duodenum in one and to the pyloric end of the stomach in

¹ Schachner, A., *ANNALS OF SURGERY*, May, 1916.

the other. On freeing these adhesions a perforation into the duodenum was found in the former and in the latter the perforation only extended through the peritoneal coat which was dissected up for a distance of half an inch on all sides of the opening.

Two of these forty cases I have since operated for renal calculi. One had also been cured of a bladder tumor by fulguration and required nephrectomy on account of the condition of the kidney. The other gave a large X-ray shadow which was interpreted as a gall-stone, but on operation it was felt to be in the pelvis of the right kidney, the gall-bladder being filled with small stones. Thirty-two months later five calculi were removed by pyelotomy. The occurrence of renal calculi in these two cases was doubtless merely a coincidence. Another case was found to have double cystic kidney, some symptoms of which were present when the gall-bladder was operated on. No return record has been obtained in this case. In 25 per cent. of this series the appendix was removed at the same time as the gall-bladder, usually through the same incision, on account of a pathological appendix.

In only one case did the X-ray show a shadow of the gall-stones and in a few others the outline of the gall-bladder was distinctly seen. But X-rays were not taken in all cases, as in the routine hospital X-ray work at Bellevue Hospital the X-ray of gall-stones has been of little positive or negative value.

The mortality in this series was 2.5 per cent.

Finally, I add a few details of the operation and the results. I believe in operation on patients with gall-stones when the diagnosis can be made and sometimes to make the diagnosis. There is no such thing as "innocent" or "harmless" gall-stones. They are all capable of harm, and so is the infected condition of the gall-bladder which usually accompanies them, and on which they depend for their formation. Sooner or later the condition is bound to become worse, and there is no medical cure. It is easier and safer to operate in the early stages before the pathological changes in the gall-bladder have become advanced, or the stones have found their way into the ducts, especially the common duct. In this way, too, we will save a few cases of early carcinoma of the gall-bladder.

Most of the cases were operated by a vertical incision over the right rectus. It is easier to remove the gall-bladder if this incision is not far (not more than 1 to 2 inches) from the midline and approaches it at the upper end. The muscle may be split, or more often retracted outward as a whole. The length of the incision depends upon the amount of adipose tissue and the difficulty of the operation. I have used the Sprengel transverse incision in five cases of this series. I have found that it gives a good but no better exposure, in most cases, than the vertical incision. In a few difficult cases I have obtained a better exposure by partly dividing the right rectus at the fibrous intersection opposite the umbilicus.

I do a cholecystectomy if there is no contraindication, as stated above.

I prefer to do this from behind forward after clamping the cystic duct and artery. The latter clamp controls most of the bleeding whether the gall-bladder is removed from behind forwards or *vice versa*. To get at the cystic duct we have to raise up the pouch at the neck of the gall-bladder, and divide a peritoneal fold usually connecting it with the hepato-duodenal ligament. This opens the gastrohepatic omentum and exposes the cystic duct to its junction with the common duct. The bed of the gall-bladder was covered by suture of the lateral flaps of peritoneum to minimize adhesions, whenever it was possible. The common duct was opened for the removal of stones in seven cases, for exploration and drainage in two, in which there was chronic pancreatitis with jaundice. In another case with jaundice from chronic pancreatitis the cystic duct was split up to allow probing of the common duct.

In nearly all cases of cholecystectomy I use a cigarette drain to the stump of the cystic duct. It would be ideal if we could close these wounds without drainage, but in a small percentage bile leakage occurs and requires drainage. The soiling of the peritoneum with bile seems to provoke peritoneal adhesions. The presence of a drain has the same effect around its course, but I believe that a drain for four or five days is of more value on the part of safety than it is harmful from adhesions.

Occasionally I have closed the wound without drainage. The convalescence was smooth or normal in 80 per cent. In two it is not mentioned, in one it was protracted by the breaking down of the wound and in another by local infection, and in one there was quite a large gastric hemorrhage, from a gastro-enterostomy. This was treated by absolute quiet and hypodermoclysis and he made an excellent recovery. Three of the four cases in which stones had recurred after a previous cholecystostomy made a normal convalescence after cholecystectomy, the other was the only fatal case. All of the seven cases of common duct stones made a normal convalescence, as did also the three cases of cholecystectomy where the common duct was drained or probed on account of chronic pancreatitis with jaundice. The drainage of bile varied from ten to twenty-eight days.

Excluding the fatal case, where severe cholangitis was present, the other four cases where pancreatitis was responsible for the jaundice were all treated by cholecystectomy, and all made an uneventful convalescence.

The three who returned reported a perfect result. In only one of these was there marked jaundice at operation. In this case the common duct was opened and drained, as it was in one other case of chronic pancreatitis. In all these cases the gall-bladder was thickened, contracted and adherent, so that there was no object in retaining it for a possible anastomosis with the duodenum, in case the pancreas caused continued obstruction to the flow of bile. In fact, there was all the more reason to remove the gall-bladder to cure the pancreatitis, if it is due to infection from the gall-bladder. In case of deep and persistent jaundice from an in-

flamed or carcinomatous head of the pancreas it would be wise to save the gall-bladder, if it is normal enough for use in a cholecystenterostomy.

In three cases the inflammation of the gall-bladder was acute enough to account for considerable oedema, especially near its neck. In such cases a cholecystectomy is often easier than usual, and acute inflammation, gangrene or threatened perforation are strong indications for cholecystectomy, provided the patient's condition or the operative difficulties do not contraindicate it. All these three patients made a normal convalescence and recovery.

No return records are recorded in ten cases in spite of the efforts of the return clinic and social service departments. The late result was excellent in 79.3 per cent., satisfactory in 13.8 per cent. One of the latter class, who was markedly improved, still eructates gas occasionally, but was accepted by the draft board. Another, who also had an appendectomy, still has some pain in the right lower abdomen, but had gained 21 pounds. In three of those not showing a perfect result constipation continued to be a marked feature after operation. The two cases classed as unsatisfactory had pain at times, one in the right upper quadrant and one in the lumbar region, though the latter was probably not due to the gall-bladder operation. The return records represent the end-results at periods varying from two months to four and a half years, and average eighteen and two-thirds months.

If the immediate and late results are as good as this in late and complicated cases they should be even better in those operated on early.

THE PRODUCTION BY CHEMICAL MEANS OF A SPECIFIC CHOLECYSTITIS

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AN ACUTELY inflamed gall-bladder was found in a dog that had been injected intravenously with a solution of chlorinated soda (Dakin's solution). Further investigation showed that this occurred in a high percentage of instances. Many experimental investigations have been made of the condition of cholecystitis, in all of which bacteria have been employed in some manner or other. The present investigation of a chemically produced cholecystitis was carried out, not because of the possibility of its having any direct bearing on the condition as it occurs in man, but because it offered an opportunity to observe the production by a chemical, of an inflammation of a particular organ. Facts have been ascertained with regard to this phenomenon as follows:

Animals Used.—The solution was injected into dogs, cats, and rabbits, the most successful experiments were conducted on dogs. While definite gall-bladder changes were produced in a few cats, on the whole, they were not satisfactory animals to work with, because the solution is more toxic to this species. Carrel has noted that the intravenous injection of the chlorinated soda solution in rabbits produces marked toxic action and this was our experience also; thus they were of no value for this investigation.

Amount of Solution Necessary to Produce the Reaction.—From 5 to 12 c.c. for each kilogram must be injected. If less than 5 c.c. are injected, the gall-bladder is rarely affected, and if more than 12 c.c. are injected, the general effect of the solution may kill the animal. In most of our experiments from 8 to 10 c.c. were injected.

Time After Injection Necessary for the Gall-bladder to Be Affected.—The inflammatory reaction of the gall-bladder seems to occur almost immediately after injection, and is certainly completed within the first twenty-four hours. As a matter of fact, if the gall-bladder of an anæsthetized dog is under observation and an intravenous injection of the solution is made, quite frequently it is possible to see the beginning injection of the blood-vessels, their rupture, and the infiltration of the tissues with blood. Well-marked gall-bladder reactions have been noted in a cat and in dogs within one-half hour after the injection of the solution into the blood-stream.

Route Taken by the Solution to the Gall-bladder.—It was at first thought that the chemical producing the reaction was excreted in the bile and thus reached the gall-bladder. This was shown not to be true, however,



FIG. 1.—Drawing of a specimen of a gall-bladder two hours after the injection of chlorinated soda solution. Note the marked acute inflammatory reaction produced.

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CHEMICALLY INDUCED CHOLECYSTITIS

because (1) the time at which the reaction occurs after injection is too short; (2) it is possible to observe the early stages of the reaction, and (3) in some animals the cystic duct was securely ligated and the gall-bladder changes took place after the injection, as when the cystic duct was patent. There can be no doubt that the chemical reaches the gall-bladder through the blood-stream.

The Chemical Substance Producing the Reaction.—The exact chemical in the solution which produces the reaction has not been determined definitely. Some of the evidence points to the chlorin. For instance, the solutions in which the available chlorin is less than 0.48 per cent., seldom produce any reaction on the gall-bladder. In several experiments chlorin water was injected. This solution is so toxic, however, that but little of it can be injected intravenously without causing the immediate death of the animal. If such a small amount were injected that the animal lived the gall-bladder was not found to have been affected. If larger amounts were injected, the animal invariably died in a short time. In one or two instances, a medium amount was reached and a few slight changes in the gall-bladder were noted. It would seem from this that the chlorin may be the active chemical agent, but the fact that the number of positive results obtained by different samples of the chlorinated soda solution was variable, seems to indicate that other factors were involved besides the chlorin. For example, with two solutions of practically the same chlorin content, one may give 100 per cent. gall-bladder reactions, while the other produces little or no effect.

The Involvement of Other Organs by the Solution.—The injection of the solution, of course, produces effects other than changes in the gall-bladder. Quite often a certain amount of nephritis may occur, and congestion of the liver has been noted. In a few instances, it was noted that the blood-vessels on the surface of the liver were injected in a manner similar to those of the gall-bladder. This was particularly true in cats, in which species these blood-vessels are sometimes quite prominent. None of the other changes appear prominently at necropsy and they certainly do not appear to differ essentially from the changes caused by the injection of some other toxic agents.

The outstanding feature usually noted at necropsy is the inflammation of the gall-bladder, which is not noted after the injection of other substances. For this reason it may be concluded that a specific chemical cholecystitis is produced, although the specific reaction seems to be on the blood-vessels on the surface of the liver and is most marked on the surface of the gall-bladder because that is more vascular.

Relation of the Blood Supply of the Gall-bladder to the Reaction Occurring After Injection.—Whether or not the gall-bladder is affected by the solution depends on several factors, one of the most important of which is the blood supply. A gall-bladder that does not have a good blood supply, particularly blood-vessels coming directly from the liver, rarely

has shown changes following injection, while a gall-bladder with a generous supply of blood-vessels from the liver that anastomose over the surface of the viscus has usually shown very marked changes. It has also been observed that gall-bladders of animals not in good condition, as those having distemper, usually develop few or no changes following injection.

Gross Appearance of the Acutely Inflamed Gall-bladder.—The gross appearance of the gall-bladder within the first twenty-four hours after the injection of the solution is that of intense inflammation. The lesions start at the fundus of the gall-bladder and on the exposed surface, usually at the point where the blood-vessels arising from the vessels in the liver on each side anastomose. The dilatation of the lymphatics usually is the first change noted after injection. The lymphatics of the gall-bladder become very prominent and are soon colored with the blood contained in them. These lymphatics can readily be traced in their course to the adjacent lymph-nodes. The reaction is not altogether specific for the blood-vessels of the gall-bladder; because the liver is shown to be also affected by the fact that the lymphatics draining the various lobes are somewhat injected, but not to so marked a degree as those of the gall-bladder. A breaking down of the small capillaries follows with a transudation of the contained blood, making minute petechiæ, which may gradually spread and involve the whole surface of the gall-bladder. At first these areas into which the blood has escaped from the vessels are red; changes then take place and most of the areas turn dark green and the entire gall-bladder has a gangrenous appearance. The organ becomes so tense in many instances that rupture seems imminent. There is usually very little, if any, œdema and adhesions to the omentum or other organs rarely form. The reaction seems to localize to a marked degree; seldom it has been seen to extend beyond the gall-bladder and cystic duct. The common and hepatic ducts do not seem to be involved in the reaction.

Microscopic Appearance of the Acutely Inflamed Gall-bladder.—The acutely inflamed gall-bladder shows first a marked breaking of the capillaries and infiltration of the wall of the gall-bladder. There are two areas of infiltration; in one the capillaries between the muscle and the serous coats are mainly or wholly affected and blood escapes and infiltrates between these two coats. In the other area the capillaries within the muscle coat are mainly affected, and the infiltration takes place between the bundles of muscle-fibres. At times this infiltration is so extensive that the whole section appears to be a mass of blood. The mucosa has not been found markedly affected primarily. In some cases, however, small hemorrhagic cyst-like areas are produced just under the mucosa; a definite ulceration of the mucosa may later occur, draining the extravasated blood into the gall-bladder.

Chronicity of the Lesions.—The reaction of the acutely inflamed gall-bladder may last for several weeks. It has been noted five weeks after

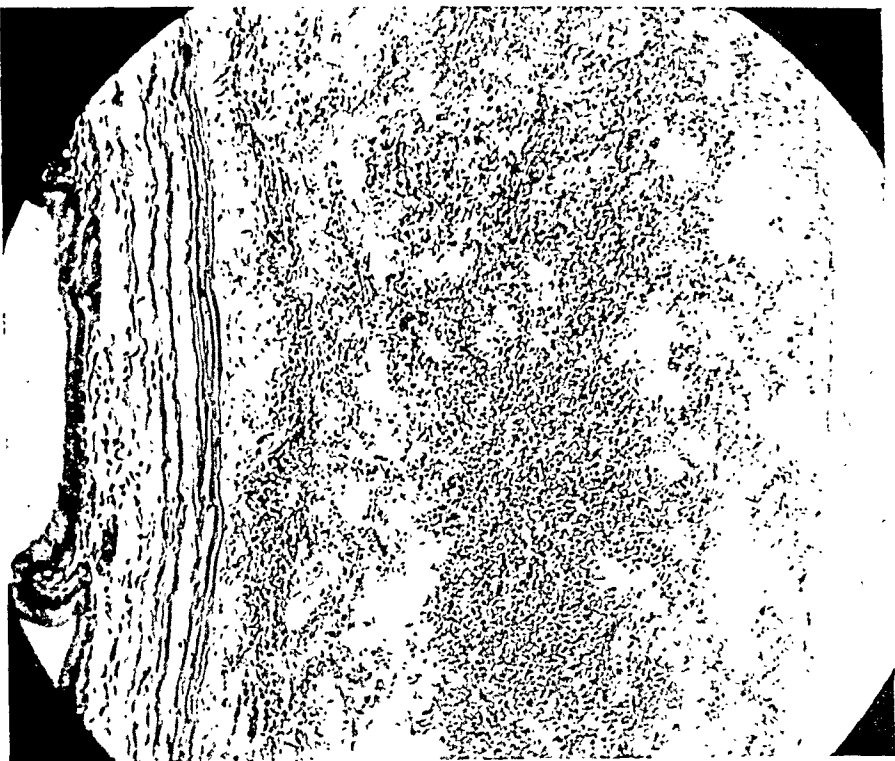


FIG. 2.—Photomicrograph of a section of the wall of the gall-bladder fifty hours after injection. In this case the infiltration of the blood took place between the serosa and the muscularis. This is the usual type of lesion produced. X100.



FIG. 3.—Photomicrograph of a section of the wall of the gall-bladder fifty hours after injection. The infiltration of the blood took place in the muscularis. X70.



FIG. 4.—Photomicrograph of a section of the wall of the gall-bladder fifty hours after injection. A small ulceration of the mucosa has occurred. The base of the ulcer is infiltrated with blood in a manner similar though to less extent than is shown in Figs. 2 and 3. This type of lesion has rarely been noted. $\times 100$.



FIG. 5.—Photomicrograph of a section of the wall of the gall-bladder forty-three days after the production of the acute condition. The organization of the blood which had infiltrated in the muscle-wall is shown. $\times 50$.

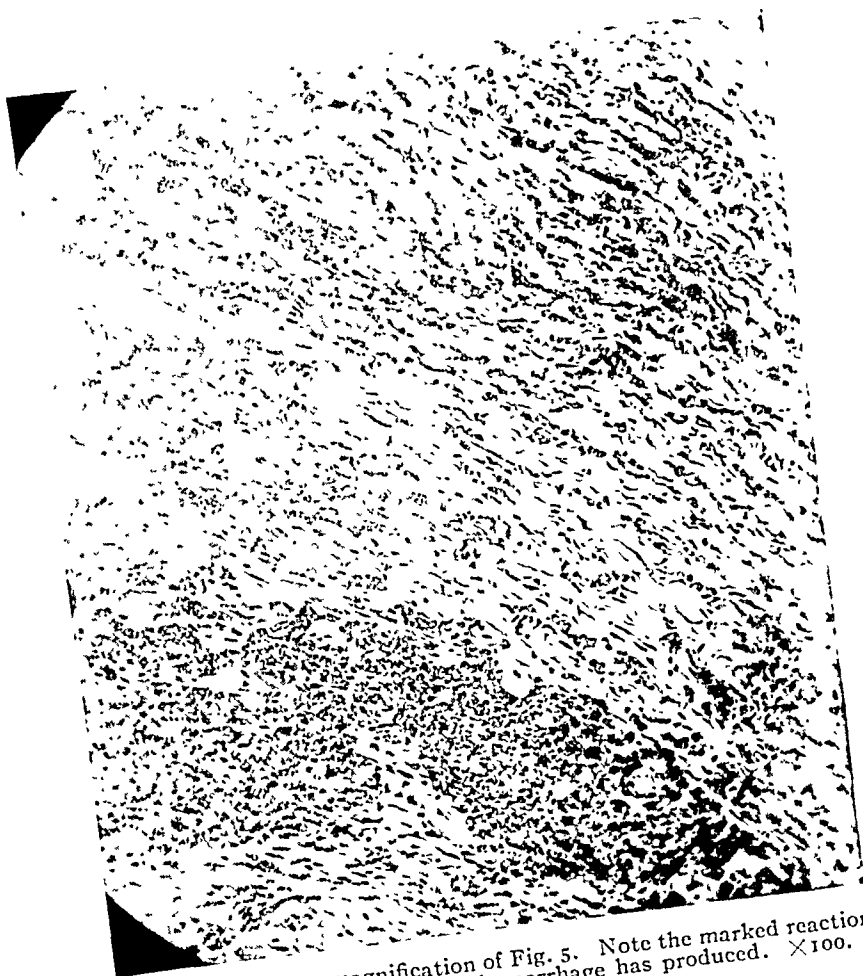


FIG. 6.—A higher magnification of Fig. 5. Note the marked reaction which the intramuscular hemorrhage has produced. $\times 100$.

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injection that the gall-bladder had practically the same appearance as it had twenty-four hours after injection. Gradually the condition clears up, and in three months it may appear normal except for a few small white scars. In some cases, however, the condition becomes chronic. Although it has not been proved definitely, it seems as if the organs which apparently returned to normal were in animals in which the extravasation of blood took place between the serosa and muscle coat, while in those in which a definite chronic condition developed, the blood infiltrated the muscle coat. The end-result of these chronic lesions has not been studied fully.

In several experiments an exploratory operation twenty-four hours after injection showed a definitely inflamed gall-bladder; the animals are still alive and in good condition several months after the production of the acute lesion. It is hoped that these experiments will furnish material for a study of chronic gall-bladder lesions.¹

SUMMARY

It has been found that the intravenous injection of a solution of chlorinated soda in dogs produces a definite reaction of the gall-bladder in a high percentage of experiments. The reaction consists of a breaking down of the capillaries and infiltration of the wall of the gall-bladder with blood.

To produce the reaction in the gall-bladder it is necessary to inject relatively large amounts of the solution, at least more than 5 c.c. for each kilogram. The reaction takes place very shortly after the injection, and is completed within the first twelve to twenty-four hours.

The reaction is undoubtedly produced by some chemical in the solution; chlorin is suggested as the probable substance. All solutions, however, even though their chlorin content may be practically the same, do not give the same percentage of gall-bladder reactions; it would thus appear that a factor other than the chlorin content was involved.

The solution reaches the gall-bladder through the blood-stream and a gall-bladder in which the blood supply, particularly that coming from the liver, is generous, develops the most marked reaction. In some instances a definite chronic condition has followed the acute condition.

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¹ This observation probably has no bearing on the use of chlorinated soda solution in the treatment of wounds. The amount of such a solution necessary to produce the reaction in the gall-bladder would be so large that it does not seem probable enough could be absorbed from a wound to produce cholecystitis. It seems that the only condition in which a large amount of the solution might be absorbed is the treatment of acute empyema. We have injected quantities (5 c.c. per kilo) of the solution into the thorax of dogs daily for several days without producing a reaction in the gall-bladder. Our work in no way invalidates the legitimate use of the solution. Carrel has emphasized that it is very toxic when injected intravenously.

HEMORRHAGIC CYSTS OF THE SPLEEN

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AND

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ALTHOUGH splenectomy is no longer an unusual operation, a few splenic anomalies are found which are not common, and which require proper consideration and care in order that the correct pre-operative diagnosis be made; and among these may be mentioned cysts of the spleen.

Historical.—The first case of splenic cyst reported was one found at autopsy, by Andral, in 1829. The first extirpation of a cystic spleen was performed by Pean in 1867. In 1891 Terrier performed a partial splenectomy successfully, and five years later Gluck treated a hemorrhagic cyst by incision and drainage. Up to 1908 there were thirty-three recorded cases of operations on cystic spleens, with complete recoveries in twenty-nine cases. Twenty-one additional cases were found post mortem.

Classification.—Dermoid cysts of the spleen are extremely rare, and echinococcus cysts are most common of all types. Splenic cysts may be classified as follows: (1) Dermoid cysts. (2) Echinococcus cysts. (3) Simple unilocular or multilocular cysts. *a.* Serous. *b.* Hemorrhagic. *c.* Lymph or chylous cysts.

The incidence is greater among females, about 65 per cent. The two cases herein reported were both in females.

Etiology.—Inclusion of peritoneal endothelium in the spleen capsule may soften, degenerate, and liquefy, thus giving rise to cysts. Due to the absence of secretory glands true retention cysts are not possible. Trauma and diseased conditions of the vessel walls cause hemorrhage. The exudate becomes encapsulated, thus giving rise to cysts. Increase in size of a hemorrhagic cyst is due, probably, to repeated hemorrhage into it. Simple cysts may be caused by occlusion of arterioles with subsequent destruction and liquefaction of the pulp.

Pathology.—The lymph-cysts are usually multiple and of small size. The hemorrhagic cysts, on the contrary, are usually large and single. Sometimes they are lined with endothelium. They may be located in any part of the organ, but are found most frequently in the anterior portion, low down, in or under the capsule. In some cases the cyst walls are thickened and calcified. Adhesions frequently occur, and these may render operative procedure more difficult. The weight of the cyst may be great enough to produce considerable transposition, a point to be con-

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sidered in diagnosis. In one case the spleen rested on the bony pelvis. The cysts seldom rupture or become infected.

Symptoms.—Small cysts seldom cause any symptoms. The larger cysts give rise to symptoms by pressure and traction. Disturbances of function are common, so that there may be a feeling of fulness, and tenderness, also respiratory, digestive, and urinary abnormalities. Pain may be present if there is a perisplenitis, if the organ is transposed, or if there is a sudden increase in the size of the cyst; but otherwise pain is absent or negligible. In its most frequent location (anteriorly) the cyst usually produces an overlying abdominal enlargement. On palpation one finds, as a rule, a fluctuating tumor.

Diagnosis.—The diagnosis may be made by one or more of the following procedures: (1) The finding of a fluctuating tumor which is definitely associated with the spleen. In some cases the tumor may not fluctuate; and in others the spleen may be displaced. Sometimes a pronounced friction rub may be heard. (2) Aspiration. Examination of the aspirated fluid may be sufficient to establish a diagnosis. Puncture should be made at the bottom of the cyst so that hydatid cyst may be differentiated. In the latter case, however, other evidence of echinococcus disease may usually be found. The fluid may be of low specific gravity, clear, with very little, if any, albumin, and not very cellular. Such a fluid is indicative of a serous cyst. In lymph-cysts the fluid will be of high specific gravity, with a large amount of albumin, and it may clot. In hydatid cysts one usually finds scolices, hooklets, or bits of lamellated membrane. Hemorrhagic cysts are, of course, evident by their bloody contents. (3) Sometimes nothing but an exploratory laparotomy will reveal the true nature of the lesion.

It is necessary to differentiate splenic cysts from cysts of the kidney, ovary, liver, and pancreas, hydronephrosis, true neoplasms, and inflammatory overgrowths in the upper left quadrant. A pre-operative diagnosis has rarely been made.

Treatment.—Bircher gives the following results of operation in thirty-three cases: (1) Puncture (by cautery)—6 cases, 2 deaths. (2) Incision and drainage—9 cases, 1 death (sepsis). (3) Resection of cyst—4 cases, 1 death. (4) Splenectomy—15 cases, no deaths.

It is seen that splenectomy is the most advisable operative procedure. Sometimes, however, dense perisplenic adhesions render splenectomy a most difficult and dangerous operation, wherefore incision and drainage is resorted to.

The following two cases of hemorrhagic cysts are reported.

CASE I.—H. M., aged twelve years. Admitted to Mt. Carmel Hospital May, 1907. The family history is negative. Complaint, tumor in the left side.

Personal History.—A few months after the child's birth the parents noticed a nodular swelling in the left side. This gradually

increased in size and was still growing at the time of admission to the hospital. The size of the growth has, of late, interfered with normal bodily movements.

Physical Examination.—A well-nourished female child who presents no abnormality except a well-defined swelling in and below the left hypochondrium. The swelling is firm, insensitive on ordinary pressure, and comes from under the left costal cartilages, at the same time moderately elevating them and the adjacent ribs. The tumor is apparently of the size of a grapefruit, takes its origin in the region of the spleen, and does not fill the loin after the manner of a renal enlargement. There is dulness over the tumor and the lower thorax in an area as large as the palm of one's hand. The urine is normal. There is no alteration of the blood other than a mild secondary anæmia. A diagnosis of splenic tumor was made, although cyst was not suspected.

Operation.—Through an incision in the left rectus muscle the tumor was exposed, and its nature was at once apparent. A thick-walled cyst as large as a fist occupied the lower pole of the spleen which above this point was moderately enlarged, and of firmer consistency than normal. The fluid in the cyst was opaque, brownish in color, with a slight greenish tinge. There were only unimportant adhesions, and removal was accomplished without especial difficulty. Recovery was rapid and uncomplicated, and the patient is now in perfect health, thirteen years after operation. The cyst had destroyed a bulk of splenic tissue equal to one-fourth of the normal organ, but the spleen above was increased in size by much more than that.

Diagnosis.—Hemorrhagic cyst of the spleen.

NOTE.—The hospital record of this case was lost during the flood of 1913, and the above history was reconstructed.

CASE II.—Miss S. R., aged twelve years, was admitted to Mt. Carmel Hospital on July 10, 1919. Service of Dr. C. S. Hamilton. Family history negative. Complaint, pain in left epigastrium.

Personal History.—Patient has had the usual diseases of childhood, but otherwise has been in fairly good health. Four years ago she fell against a wooden step, injuring herself in the epigastrium. She felt sick for a few days. There was no swelling noticed at the time. Five months ago she was again injured in a similar manner, which necessitated her staying in bed for several days.

Present Illness.—Patient first noticed a swelling seven months ago, about the size of an egg. This disappeared in two months, but after her last injury the swelling reappeared and grew rapidly. The tumor is not painful and apparently does not interfere with heart or respiration. The patient appears less energetic than formerly, and has lost three pounds in weight. Appetite good.

Physical Examination.—Heart loud, irregular sounds, misses every sixth or seventh beat. Lungs normal. Abdomen, soft mass in left hypochondrium. Feels cystic. It is bounded by a line starting at the ensiform cartilage and passing around the left costal

margin to the end of the eleventh rib, and then to a point midway between the umbilicus and the ensiform. Its transverse diameter is 7 inches. Longitudinal diameter 6 inches. It is raised above the surrounding abdominal wall about $1\frac{1}{2}$ inches. It moves with respiration. It does not extend to the back. It extends under the ribs and raises them. There is fluctuation. It is not tender to palpation.

Laboratory Report.—Urine normal. Blood: reds, 4,102,000. Leucocytes, 10,000. Polynuclears, 62 per cent. The blood picture is that of a very mild secondary anæmia.

Operative Notes.—A tense fluctuating tumor, not especially sensitive, projects strongly in the left epigastrium to a point slightly beyond the median line, as low down as the navel, and lifting markedly the sixth, seventh, eighth, and ninth ribs in front, with dulness extending backward on these ribs slightly beyond the posterior axillary line. Long incision in the left rectus muscle with a slight prolongation along the margin of the ribs toward the median line. The tumor, which is a cyst of the spleen, is covered with adhesions of omentum, which must be released. There are also adhesions to the diaphragm which are divided between ligatures. The cyst is then opened, and discharges a coffee-colored fluid which is evidently altered blood. The removal of the spleen is then easily accomplished, ligating the pedicle in four or five places, avoiding the pancreas and stomach without difficulty. The bed of the spleen shows some disposition to bleed, therefore a hot towel pack is applied, and removed at the end of suturing. A good-sized tube drain is inserted. The patient made an uninterrupted recovery, and left the hospital two weeks later.

Pathological Report.—The original mass measures 15 x 15 x 8 cm. It has been incised. The outer lower third is of normal appearance and consistency. The remaining portion is of mottled appearance, and is covered with adhesions. On section one finds a single large cyst, with a roughened fibrous wall. The wall varies in thickness from $\frac{1}{2}$ to 4 mm., and is lined with an intricate network of anastomosing blood-vessels.

Microscopic Appearance.—The serous covering is of normal appearance. The thickened capsule is composed of elastic fibres, smooth muscle-cells, and connective tissue. A few areas present degenerative changes of a hyalin nature. There is a moderate diffuse hemorrhagic infiltration, and occasionally one finds patches of modified blood pigment. In some of these pigmented areas are occasional foreign-body giant-cells. Capillaries and small vessels are distributed throughout the capsule. A mild diffuse infiltration of lymphoid cells and occasional pus-cells occurs. At a few points there are small amounts of pulp tissue attached to the cyst wall. The walls of the arteries in the pulp are abnormally thick. The Malpighian bodies are not numerous, but are of normal size and appearance. That portion of the spleen which was not involved in the cystic process is of normal appearance.

The fluid from the cyst measures 620 c.c. in volume. It resembles in appearance black coffee. Its specific gravity is 1022. Microscopically one finds nothing but red blood-cells, mostly in rouleaux formation, and a few white blood-vessels.

Diagnosis.—Simple hemorrhagic cyst of the spleen.

POLYCYSTIC KIDNEYS AND LIVER*

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PATHOLOGISTS are familiar with the various congenital anomalies of the abdominal viscera, through autopsy findings. Until recently the clinician was of the opinion that these variations from the normal in the form, location, and structure of abdominal viscera as the result of errors in development were not of any importance in the consideration of the diagnosis of a given clinical picture in the living. Frequent mistakes, however, in this direction have emphasized the necessity of a thorough acquaintance with every possible congenital anomaly in order to avoid some of the pitfalls of diagnosis. This is especially true of the results of developmental changes in the urinary tract,

One of the most instructive examples in which the persistence of embryonic defects gives rise to a series of puzzling clinical pictures is seen in the condition commonly called polycystic kidney. In these cases the kidneys are converted into a series of cysts of varying size (Fig. 1). The most generally accepted theory as to the origin of the condition is that of Berner,¹ namely, the tubules which arise from the Wolffian duct in the embryo fail to unite with those of the glomerular system. I have recently² discussed the entire subject from the clinical standpoint and would refer those who are interested to this article. Both kidneys are involved at some time or other in nearly 85 per cent. of the cases,³ so that although nephrectomy is performed on the most involved side, life is not greatly prolonged as the opposite kidney continues to undergo the same changes. The disease occurs in the embryo and again after middle age (forty to fifty years), the latter form the majority.

In 18 per cent. of the cases a similar condition is found in the liver. As in the kidney, the parenchyma is gradually pushed aside or replaced by cysts varying in size from a pinhead to the size of an adult head.

The clinical pictures which the condition most frequently presents are the following:

1. Symptoms of renal insufficiency, that is, uræmia of varying intensity according to the amount of kidney tissue not involved;
2. Hæmaturia as the principal symptom. This also varies greatly and may be very severe and constant or of less amount and intermittent;
3. The presence of a unilateral or bilateral abdominal tumor, which

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¹ Virchow, Archiv, 211, 265, 1913.

² Surg. Clinics of Chicago, 3, 1057, Oct., 1919.

³ Luzzato: Degen. Cistica dei Reni, Venise, 1900.

POLYCYSTIC KIDNEYS AND LIVER

can usually be differentiated from an intraperitoneal tumor by the changes in pelvic outline as shown in a pyelogram;

4. Pain of a dull, aching character as the result of increased intrarenal tension. The pain is never severe unless infection or hæmaturia supervenes.

Fever is not present, as a rule, unless infection complicates the cystic condition. That the symptoms of renal infection may predominate and thus obscure the real underlying disease is not as generally known as it deserves to be. The following case is an example of this rather unusual condition.

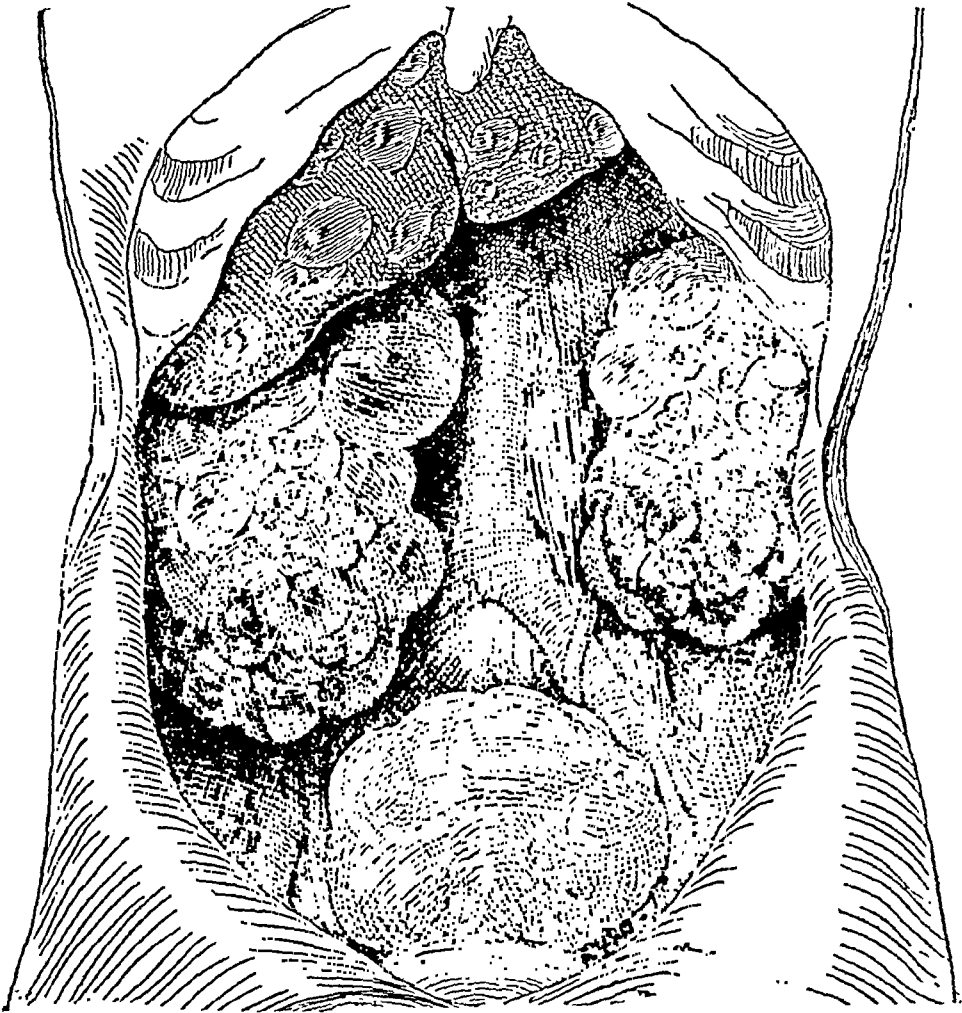


FIG. 1.—Conditions found at operation in case of a congenital cystic liver with bilateral congenital cystic kidneys. The lobulated tumor filling the true pelvis was a fibroid of the uterus.

A woman aged forty-four years was admitted to my service at the County Hospital with a history of sharp pains in the right upper quadrant of the abdomen for the preceding six months. The attacks would recur about once a week and last from four to five hours. She was perfectly well in the intervals. Nine days before admission during an attack of similar pain she had a severe chill and rise of temperature to 104° F., followed in the next thirty-six hours by two similar cycles. A prominence was noticed by the patient in the gall-bladder region soon after the onset of the present attack.

There were no disturbances of urination. The pain remained localized to the right upper quadrant and did not radiate.

Examination of the abdomen revealed a tender prominence just below the costal arch (Fig. 1) extending downwards from the liver and inwards almost to the median line. The diagnosis rested between a hydrops of the gall-bladder with cholelithiasis and a hydronephrosis.

Cystoscopy gave negative results and catheterization of the right ureter for the purpose of pyelography was impossible on account of the presence of a large uterine fibroid which completely filled the true pelvis. The urine showed the presence of a number of pus cells.

An exploratory right rectus incision was made and revealed the presence of multiple cysts (Fig. 1) varying in size from a pea to a walnut, scattered over the surfaces of both lobes of the liver as high up as the diaphragm. The gall-bladder was normal. Both kidneys were the seat of innumerable similar cysts. One of these, the size of a hen's egg, projected directly downwards beneath the right lobe of the liver and thus simulated a distended gall-bladder.

The right kidney was almost twice the size of the left one, but both showed an advanced polycystic condition.

My chief object in presenting this case is that (*a*) one seldom encounters the combination of polycystic liver and kidneys during life. The frequency of such an association based upon autopsy findings is only 18 to 19 per cent.; (*b*) the unusual clinical picture. The symptoms of renal infection predominated to such an extent as to completely mislead us.

Even inflation of the colon would have been of no assistance, since this structure did not lie in front but to the inner side of the tumor. Pyelography might have been of some diagnostic aid, but was impossible.

RENAL TUBERCULOSIS IN TWINS*

BY HERMAN L. KRETSCHMER, M.D.

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THE two cases about to be reported have several points of interest that merit placing them on record. These points are: (1) The occurrence of renal tuberculosis in twin girls. (2) The youth of the patients. (3) In one of the cases a bilateral process was demonstrated. (4) The demonstration of extensive calcification in renal tuberculosis in young individuals. (5) Calcifications in the bilateral case occurred in the right kidney. (6) In the unilateral case the right kidney was involved and it showed extensive calcification.

OCCURRENCE

With reference to the occurrence of renal tuberculosis, it is generally stated to be a disease of adult life. The occurrence of this disease in childhood is not very common, at least, judging by published statistics. It may be possible that it occurs more commonly than is evident, on account of being overlooked or not recognized. Close study of a large series of cases seems to bear out the general clinical impression that this disease is rare in infancy and childhood.

Braasch has recently reported a series of 532 cases of renal tuberculosis. Two patients were under ten years of age (0.4 per cent.) and 37 cases occurred in patients in the second decade of life (6.9 per cent.). Wildbolz, in his series of 245 cases, reported 17 cases in the second decade. Heubner, in his "Lehrbuch," states that he has seen but few cases of the disease in children. Viguard and Thévenat have collected a series of thirty-eight cases of renal tuberculosis in children and found the following distribution with reference to age: Up to four and one-half years, 4; from three to five and one-half years, 8; from six to ten and one-half years, 9; from eleven to sixteen years, 17.

Leedham-Green believes that instead of regarding renal tuberculosis as a relatively rare disease which, when present, is difficult to alleviate and hopelessly incurable, we should now consider it as exceedingly common. His statements, however, do not seem to be verified by the above-quoted statistics.

Kapsammer, in his series of sixty-two cases of renal tuberculosis, reported five cases in the second decade. One of these was fifteen, two were nineteen, and two were twenty years old. One of his cases was bilateral.

* Cases reported before the Chicago Urological Society, February 4, 1920.

CASE I.—Lenore P., aged fourteen years. Referred by Dr. Harry Bell. Admitted to the Presbyterian Hospital September 20, 1919.

Previous Illnesses.—Patient states she has had measles, smallpox, whooping cough, and several attacks of tonsillitis.

Menstruation began at the age of twelve and was regular until onset of present trouble. Since then, periods have been delayed one or two weeks.

Family History.—Father, aged forty-seven years, living and well. During his childhood he suffered from *white swelling of the left knee*, as a result of which the lower extremity is very short and atrophic. Mother, aged thirty-six years, has recurring attacks of cystitis. An aunt and an uncle both have healed pulmonary tuberculosis. A twin sister, whose history is given below (Case II), has a complaint similar to that of the patient.

Present Illness.—This began in February, 1919, with painful urination, which gradually grew worse until July, 1919. Pain boring and burning in character; present during urination. In July patient states she became so ill that she could not walk because of pain in the bladder region. This pain was dull in character, similar to pain on urination; relieved when sitting or lying down; aggravated by motion or exercise. At night it was necessary for her to lie on her back to be comfortable. In August, 1919, she had two attacks of hæmaturia on two consecutive nights. No premonitory symptoms preceded the hemorrhages. Attacks of bleeding have always been at night; two attacks of hæmaturia since August. In February, 1919, she began to get up once a night to void. Continued to get up only once at night until August, 1919, when urination was more frequent at night. At times, some hesitation in starting the urinary stream: sometimes the stream would suddenly stop and then start again. No pain in the region of the kidneys.

Patient stated that she had always been outdoors a great deal and slept outdoors winter and summer.

Physical Examination.—A well-nourished girl, with a slight pallor. Pupils equal and react to light and accommodation. Slight nystagmus. Esophoria of right eye. Teeth well kept; signs of much repair. Tonsils moderately enlarged. Bean-sized hard glands present at anterior border of left sternocleidomastoid muscle. Lungs show normal expansion and borders; normal vesical murmurs; no râles. Heart borders normal; tones clear; no murmurs; rate, 120. Abdomen negative except for some slight rigidity of the abdominal muscles. Some tenderness in the bladder region. Kidneys not palpable. No changes noted in the spine. Patellar, ankle, triceps and humeri reflexes, normally active.

Blood Examination.—Erythrocytes, 4,340,000; leucocytes, 7200; hæmoglobin, 85 per cent.

Urinalysis (September 20, 1920).—Alkaline; pale, straw-like in color; trace of albumin; sugar and blood negative. Many leucocytes; a few calcium oxalate crystals and amorphous phosphates.

RENAL TUBERCULOSIS IN TWINS

X-ray Examination—Chest.—For the most part the chest was quite clear. Two small dense nodules noted a short distance from left hilum; right hilum rather heavy, especially in descending branch. No signs of active pulmonary tuberculosis. *Genito-urinary Tract.*—Presence of four large shadows in the region of right kidney (Fig. 1). The three larger shadows showed a dense margin, the centres being lighter and of more or less irregular density. The fourth, or lower shadow, did not have so dense a margin as did the three upper shadows. Left kidney, ureters and bladder, negative.

Cystoscopic Examination (September 22, 1919).—Bladder capacity, 35 c.c. Very severe generalized cystitis with many areas of ulceration. Several large areas of ulceration in apex of bladder and large flakes of pus adhering to the bladder wall. A few small areas of ulceration noted around the left ureteral orifice. Both ureters were catheterized without difficulty or obstruction. Examination of the urine obtained upon catheterization showed the following:

TABLE I.

	Bladder	Right Ureter	Left Ureter
Leucocytes per cu. mm.	1290	450	2400 (bloody).
Cultures.	B. Coli	Sterile	Sterile.
Stain for T. B.	T. B. present	T. B. present	None found.
Guinea-pig inoculation. ....	.....	T. B. present	T. B. present.

The two pigs injected with urine from the right and left ureters showed, at autopsy, the presence of tuberculous nodules in the spleen and tuberculous abscesses in the groin at the site of injection.

An intravenous phenolsulphonephthalein test was made:

TABLE II.

	Right	Left
Time of appearance.	7 minutes	6 minutes.
Output first 30 minutes.	27 per cent.	31 per cent.
Output second 30 minutes.	6 per cent.	15 per cent.
Total.	33 per cent.	46 per cent.

As a result of the guinea-pig test, a diagnosis of bilateral renal tuberculosis was made.

A second cystoscopic examination made on October 17, 1919, showed essentially the same cystoscopic picture as at the first examination.

Because of the presence of a bilateral renal tuberculosis, it was decided not to institute any operative procedure.*

CASE II.—Lucille P., aged fourteen years. Entered Presbyterian Hospital September 20, 1919. Patient is twin sister of patient whose history is given above.

* A recent communication from the patient's family states that patient died six months after dismissal from hospital.

Previous Illnesses.—Patient has had measles and whooping cough.

Menstrual periods began at the age of twelve and have been regular since the age of thirteen.

Present Illness.—This began about twenty months prior to admission to hospital, at which time patient was obliged to urinate twice or three times at night. Frequency of urination has been present since onset of trouble. At times there is an increased frequency,

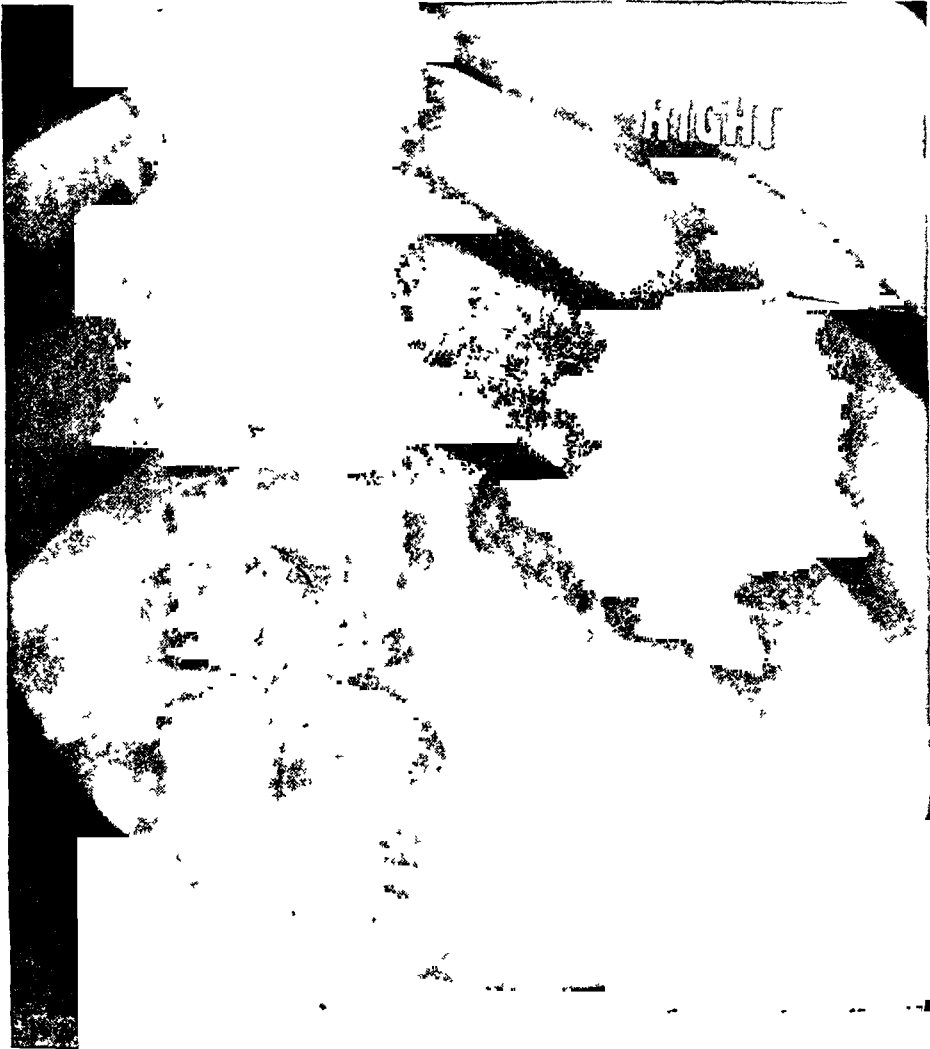


FIG. 1.—Lenore P. Showing the presence of extensive calcification in the right kidney in case of bilateral renal tuberculosis

so that patient voids as often as five times at night. Frequency is less in warm weather and aggravated by exposure to wet and cold. Patient has had twelve attacks of hæmaturia: these lasted from twelve to twenty-four hours. Attacks of hæmaturia have been brought on by exercise or excitement, and, as a rule, they cease during the night and the patient feels relieved by bleeding. Some pain, described as dull or an ache, and soreness in the region of the bladder, aggravated by walking, bending, or standing, and relieved by sitting or lying down. During the attacks of hæmaturia pain is

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absent; intense, on the other hand, when the bladder is completely empty or fully distended. A small amount of urinary dribbling. This has not been constant.

Physical Examination.—Pupils equal. React to light and accommodation. No nystagmus or ocular deviation. Nares patent. No marked septal deviation. Teeth well kept; dental repair. Tongue pink, smooth, and not trembling. Pharynx pink. Tonsils moderately large and cryptic. No palpable adenopathy or rigidity of neck. Thyroid gland of normal size. Lung expansion symmetrical and good; resonance normal; borders normal; vesicular murmur

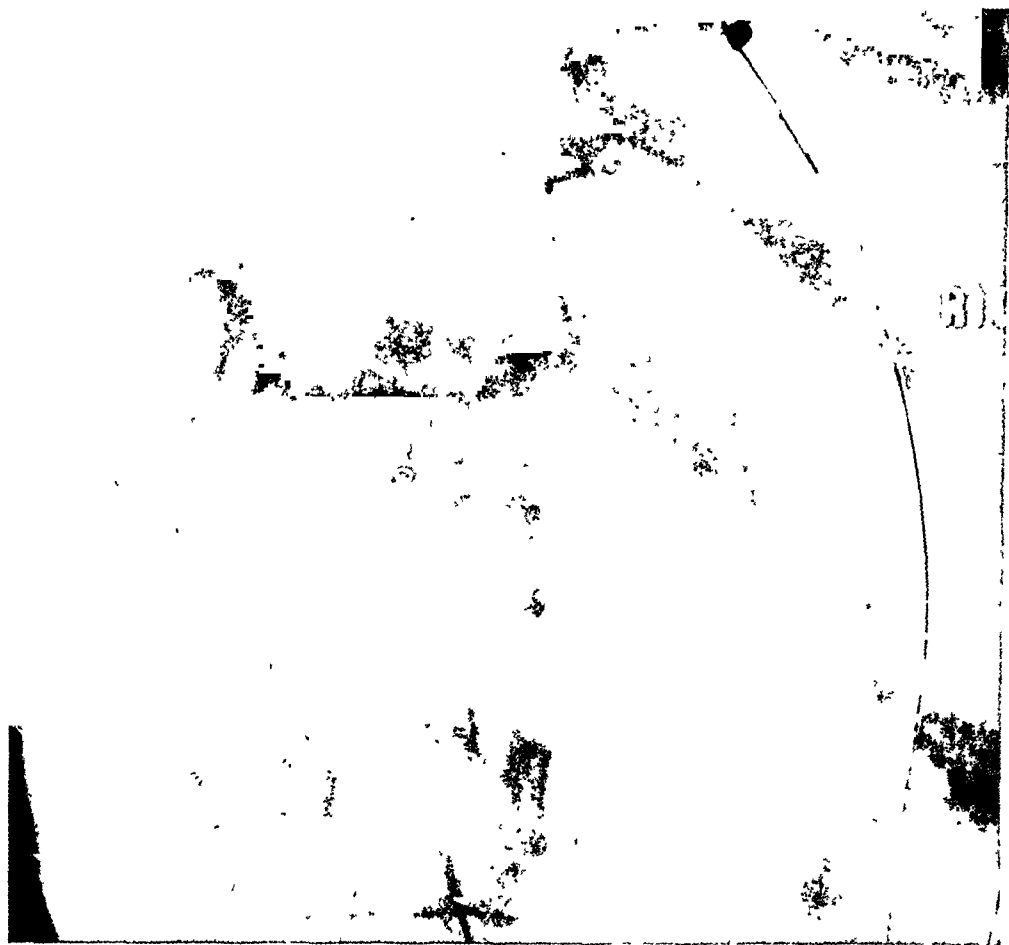


FIG. 2.—Lucille P. Showing the presence of calcification in the region of the right kidney. Not as extensive as was the calcification in Case I.

not altered and no râles. Heart borders normal; tones clear; rate, 110. Slight amount of rigidity of abdominal muscles; no areas of tenderness. Right kidney palpable. Slight amount of tenderness over the bladder upon percussion.

Examination of Blood.—Erythrocytes, 4,900,000; leucocytes, 6200; hæmoglobin, 85 per cent.

Urinalysis (September 21, 1919).—Acid: trace of albumin; sugar and blood negative. No casts; many epithelial cells and leucocytes; few amorphous urates.

Röntgen-ray Examination—Chest.—Moderate hilum densities with slightly increased density along bronchi, extending rather uniformly

fairly well out toward the periphery. In the upper left lung several small, dense nodules, extending outward and upward from the hilum, suggestive of an old tuberculous process. No signs of active pulmonary tuberculosis. *Genito-urinary Tract*.—Negative for the presence of calculi. In the region of right kidney a collection of shadows which extended from the transverse process of the second lumbar vertebra to the upper border of the last rib, and from the lower border of the first lumbar vertebra to the lower border of the second lumbar vertebra (Fig. 2). Shadows irregular in density. Well-defined borders of shadows seen in Case I absent.

Cystoscopic Examination.—Bladder capacity very limited. Several large areas of ulceration in apex of bladder. Left ureteral orifice normal; right ureteral orifice retracted and dilated (golf-hole ureter). Many large flakes of pus adhering to the bladder wall. Left ureter catheterized without difficulty or obstruction. Four catheters used in attempt to catheterize right ureter. All catheters passed up the ureter for about 2 cm., beyond which point it was impossible to pass catheters, hence no urine from the right ureter could be obtained. Examination of the urine showed the following:

TABLE III.

	Bladder	Right Ureter	Left Ureter
Leucocytes per cu. mm.	1750	No specimen	1200
Cultures.	B. Coli	.....	B. Coli.
Stain for T. B.	T. B. present	.....	None found.

A second cystoscopic examination was made on October 10, 1919. Cystoscopic findings at this time were practically the same as at the previous examination. The left ureter was catheterized without difficulty or obstruction. It was impossible to catheterize the right ureter because of an obstruction 2 cm. above the ureteral opening. Examination of the catheterized urine showed the following:

TABLE IV.

	Bladder	Right Ureter	Left Ureter
Leucocytes per cu. mm.	1,000,000 or more cells	No specimen	126
Cultures.	Staphylococci	.....	Sterile.
Stain for T. B.	T. B. present	.....	None found.
Guinea-pig inoculation.	T. B. present	.....	Negative.

The pig injected with the urine from the bladder showed the presence of a tuberculous abscess in the groin at the site of injection and the presence of large tuberculous nodules in the spleen; the pig injected with the urine from the left kidney was negative for the presence of tubercle bacilli.

Operation (November 6, 1919).—Under ether anæsthesia the usual oblique lumbar incision was made and a right nephrectomy per-

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formed. Patient made an uneventful recovery. Fissure closed in three weeks. Following the operation there was a rapid improvement in the urinary symptoms and at the present time, patient is free of bladder distress.

The amount of calcification in both cases was rather extensive as evidenced by the Röntgen plates. In other cases of renal tuberculosis, which röntgenologically showed evidence of calcification, the shadows seen were very much smaller than in either of the cases above mentioned.

For several years past, all cases of suspected renal tuberculosis, as well as assured cases, have been radiographed as a routine. It is surprising how often areas of calcification in the kidney region are found; hence Röntgen-ray examinations are dependable in giving additional information which in certain circumstances is not only helpful but desirable.

There are cases in which, by reason of extensive tuberculosis of the bladder, cystoscopy can be carried out only with difficulty and in which the success of ureteral catheterization is questionable. In these cases it is impossible to establish with surety the location of the tuberculous process in the right or left kidney. Hence, if by an uncomplicated procedure, such as röntgenography, the question of right- or left-sided renal tuberculosis may be readily settled, there can be no doubt that we have a simple, easy, and painless method at our disposal.

But this procedure is not unaccompanied by the possibility of a grave source of error—namely, the overlooking of a possible tuberculosis in the opposite kidney. In Case I, reported above, this error would have been committed had we been satisfied with the Röntgen plates and the demonstration of tubercle bacilli in the urine. As a result, a diagnosis of right-sided renal tuberculosis would have been made. Therefore, even though the Röntgen-ray examination, when positive, gives valuable information, it should not be wholly depended upon to the exclusion of ureteral catheterization; for despite the fact that the opposite side does not show calcification, it is *not proof positive* that renal tuberculosis may not be present. This was the status in Case I.

THE TECHNIC OF THE OPERATIVE TREATMENT OF NEOPLASMS OF THE URINARY BLADDER*

BY EDWIN BEER, M.D.
OF NEW YORK, N. Y.

THE treatment of growths of the bladder has been for many years one of the problems of the profession, and it is only recently that a certain uniformity in therapy is beginning to prevail. Prior to 1910 it was generally recognized that a patient suffering from this ailment had a hard road to travel, as operative removal of the growth was so very frequently followed by recurrence of the old trouble. With the introduction of the method of high frequency cauterization through an ordinary catheterizing cystoscope, it is fair to say that a great change has been effected in the treatment of these previously so difficult cases. It was evident, however, from the start, that though this new method was very effective in the treatment of benign papilloma, in malignant tumors it had no field. Moreover, it soon became manifest that even in benign growths of the papillary type there were certain limitations to its usefulness. I have repeatedly emphasized these points during the past ten years, and have urged the profession not to employ this electrical cauterization for the cure of malignant growths as well as in benign growths (*a*) that are not readily accessible; (*b*) that surround the sphincter and bleed so that a thorough treatment is impossible; (*c*) that are so numerous that the bladder is studded with tumors (papillomatosis); (*d*) those cases that for one reason or another are intolerant and can not be regularly cystoscoped. The treatment of these five groups has constituted the modern problem as it presents itself to us to-day. And during these last ten years I have given it my earnest attention with the hope of evolving a surgical technic that would prove more successful than the older methods. It is a description of this technic that I wish to present to the Society to-night, as I am convinced that it marks a distinct advance in the surgery of this condition.

The more carefully one studies the results of surgery of bladder neoplasms, the more evident it becomes that the successful treatment depends upon the avoidance of tumor-cell implants, for recurrences, except in the infiltrating malignancies where they may be due to incomplete operations, are usually due to such implants. Consequently it is necessary in working out a technic for these cases to keep this constantly in mind, and every step of the operation must be so worked out as to avoid implanting tumor-cells on raw or cut surfaces. The successful treatment of papillary growths, benign and malign, is, strange to say, a better test of a method of treatment than the treatment of infiltrating carcinomata, as in the latter it is always difficult to determine whether one has removed

* Read before the New York Surgical Society, October 27, 1920.



FIG. 1.—Wide extraperitoneal suprapubic exposure of bladder in moderate Trendelenburg position after irrigation and emptying of organ.

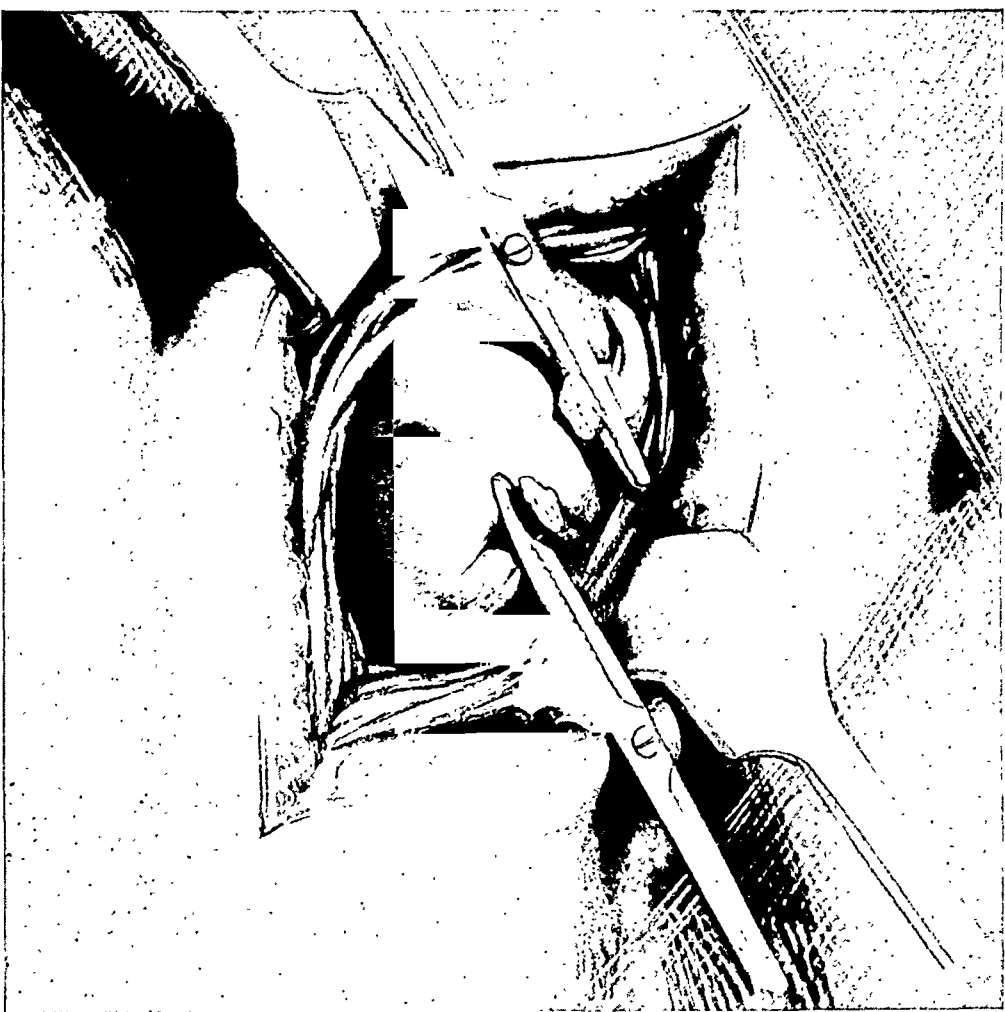


FIG. 2.—Liberation of bladder from its bed. Division of urachus. Bladder pulled out of abdomen.



FIG. 4.—Heavy gauze pads surround the bladder and carefully protect all parts of the wound. Incision through posterior wall of bladder. Edges of incision seized with curved blunt forceps. (Carmalt type.)

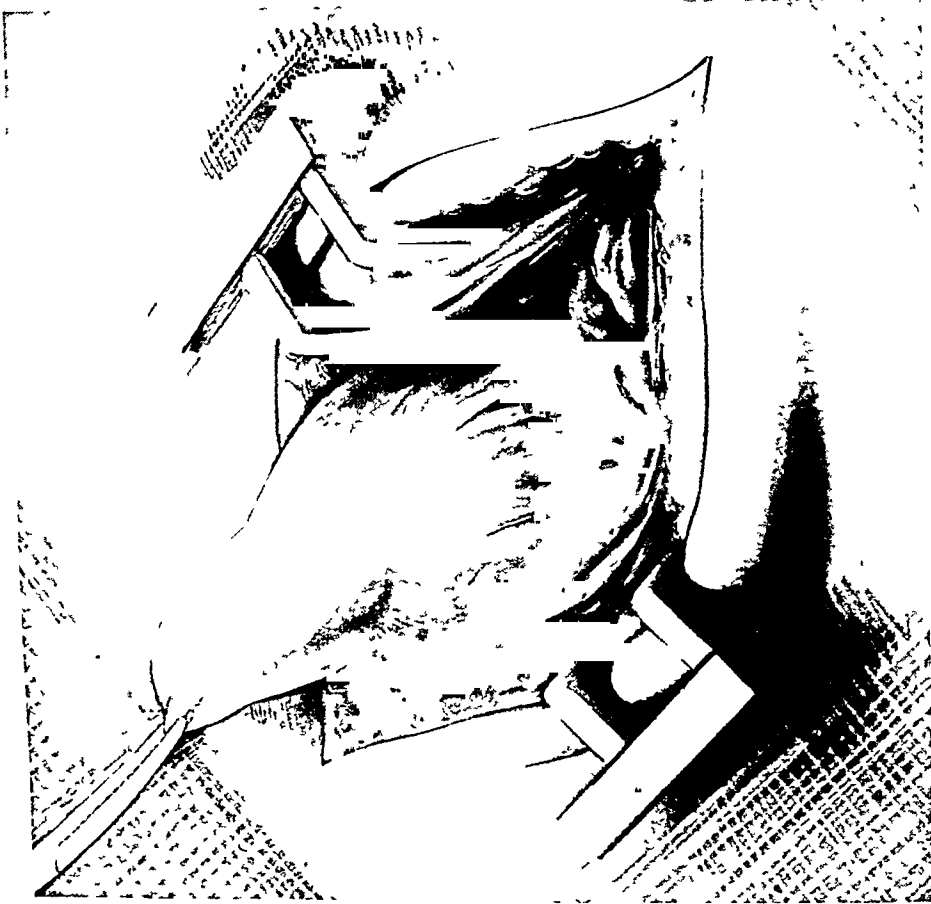


FIG. 3.—Bladder completely freed by sponging off peritoneum and perivesical nonadherent fat. Posterior surface of bladder presenting as apex is drawn over pubes.

OPERATIVE TREATMENT OF BLADDER NEOPLASMS

all the cancerous or tumor tissue or not, while in the former such difficulties are much less frequent. The cure of cases of papillomatosis speaks well for a surgical procedure, and is an excellent test of such a procedure, while recurrences speak against such a procedure. The cure of infiltrating carcinomata may speak well for a method of operating, though usually a large element of good luck enters, while a recurrence in view of the difficulty of deciding the microscopic progression of the disease does not necessarily condemn such a method.

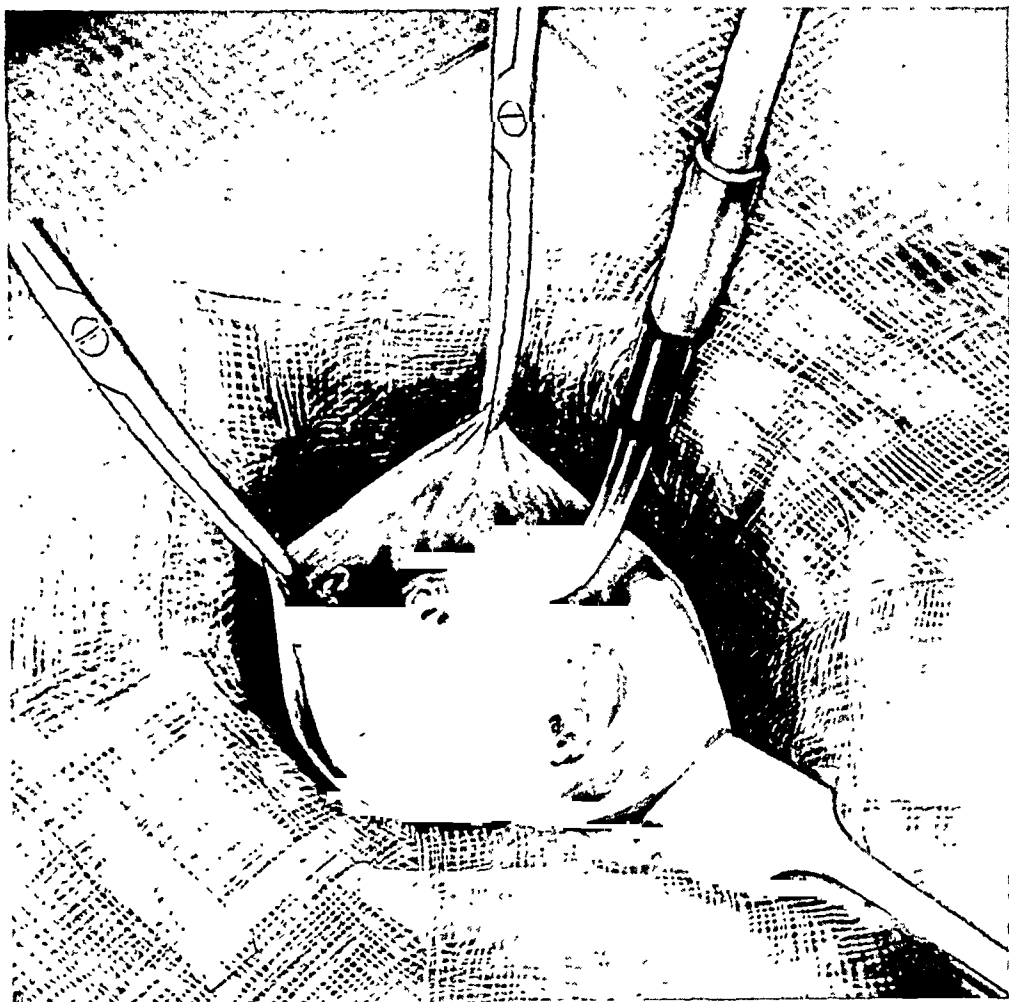


FIG. 5.—The incision in the bladder has been gradually enlarged exposing numerous papillary tumors. With the cautery they are burnt to a crisp and their bases destroyed. (See text for resections and ureter implantations.)

To avoid implants has been the main aim in working out the method to be described. Even under the older methods when less attention was given to this side of our problem, occasional operative cures were scored, but with our minds alert to the frequency of implants and doing everything now to avoid them, our results have improved to such an extent in the non-infiltrating neoplasms that I feel inclined to aver that the operative results are nearly as good, if not as good, as those obtained in suitable cases with the transurethral method, and in view of the fact that these cases are the most difficult, this speaks very well for the operation which I am going to describe.

The technic briefly is as follows. With the illustrations I believe I can make many of the points clearer.

1. The bladder is gently irrigated and then emptied so that when it is opened the wound is not flooded with fluid containing tumor-cells.
2. The patient is placed in moderate Trendelenburg position and a wide vertical suprapubic incision is made.
3. As the bladder is exposed extraperitoneally it is freed from its bed of fat and peritoneum by blunt dissection to either side of the urachus,

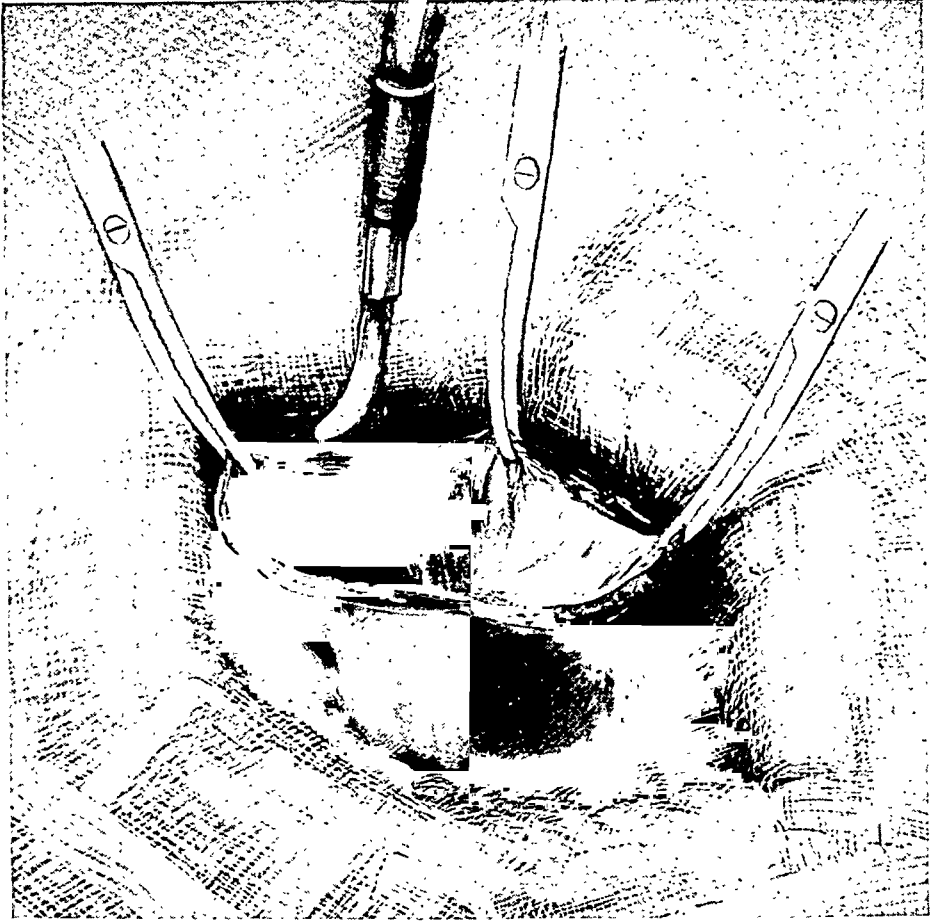


FIG. 6.—Wound in bladder is carefully seared, each clamp being removed as it is reached. Then all clamps off, and the patient being lowered, the wound (including the bladder) is completely filled with alcohol.

which is double clamped and cut between. The clamp in the bladder end of the urachus is used to draw the bladder forward and towards the symphysis as the peritoneum is sponged off its posterior surface. This may be opened accidentally and will allow of palpation of the extent of infiltration, etc., of the walls of the bladder.

4. After the bladder has been well freed down to the trigone in this manner, and delivered well out of the abdomen, the perivesical space is carefully packed off with several layers of gauze abdominal pads which protect the perivesical space and the incision in the parietes.

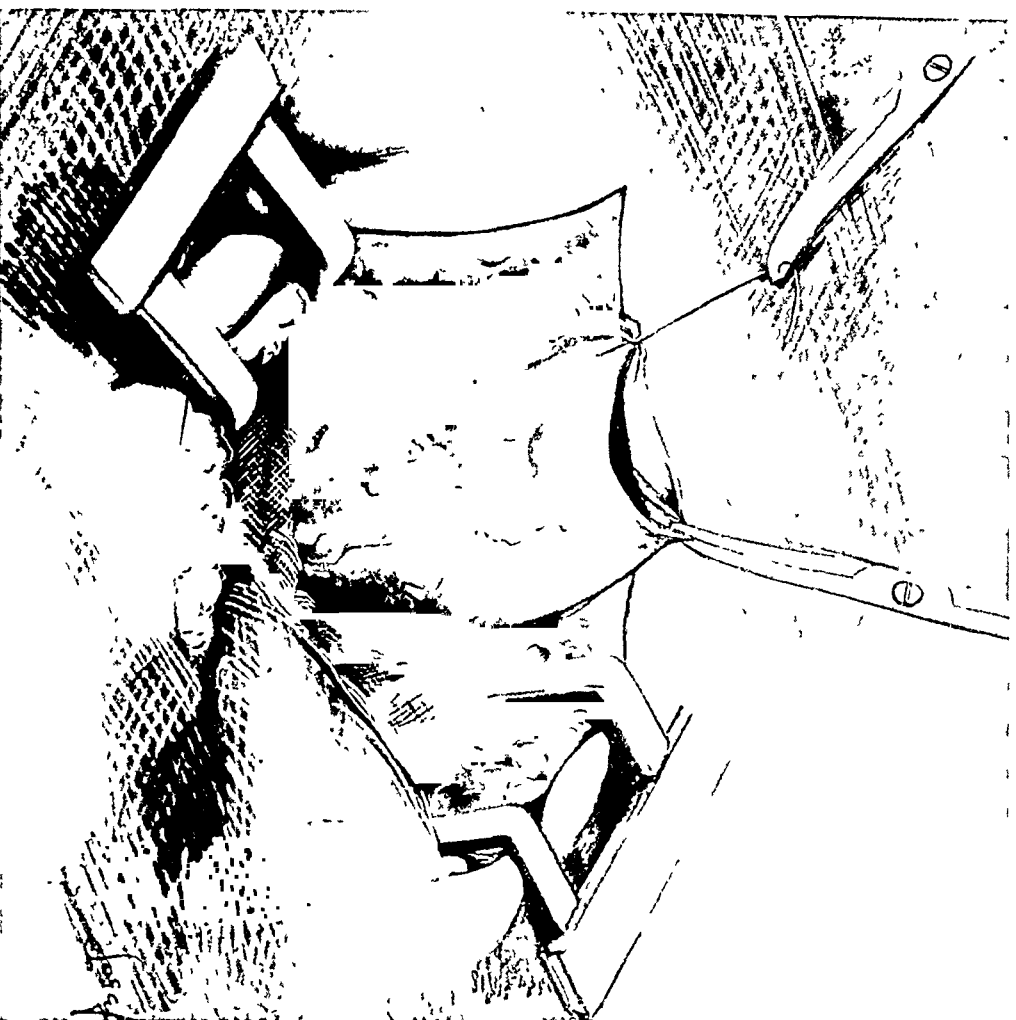


FIG. 7.—After removal of soiled gauze and of the alcohol, the charred incision in bladder is inverted with two layers of sutures leaving adequate opening for tube drainage.

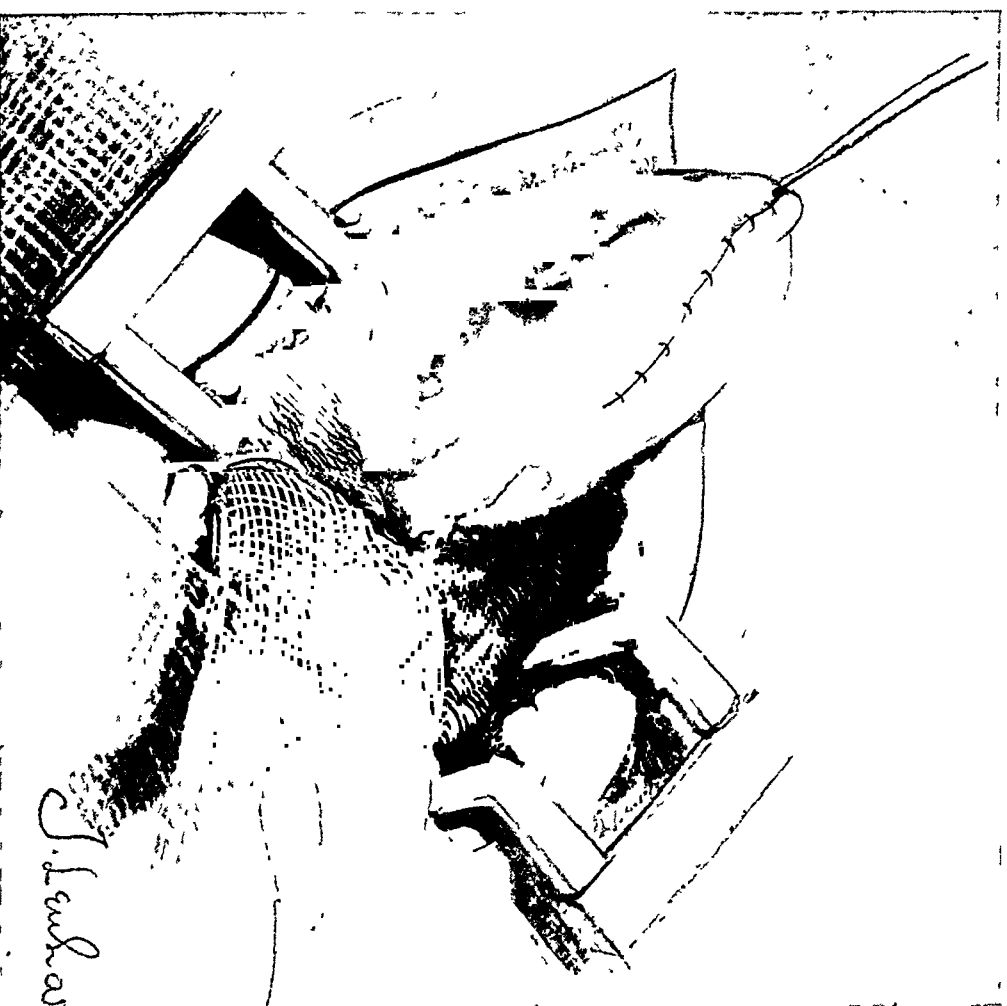


FIG. 8.—Outer layer of chromic catgut closing the incision in the posterior wall before replacing organ in its bed.

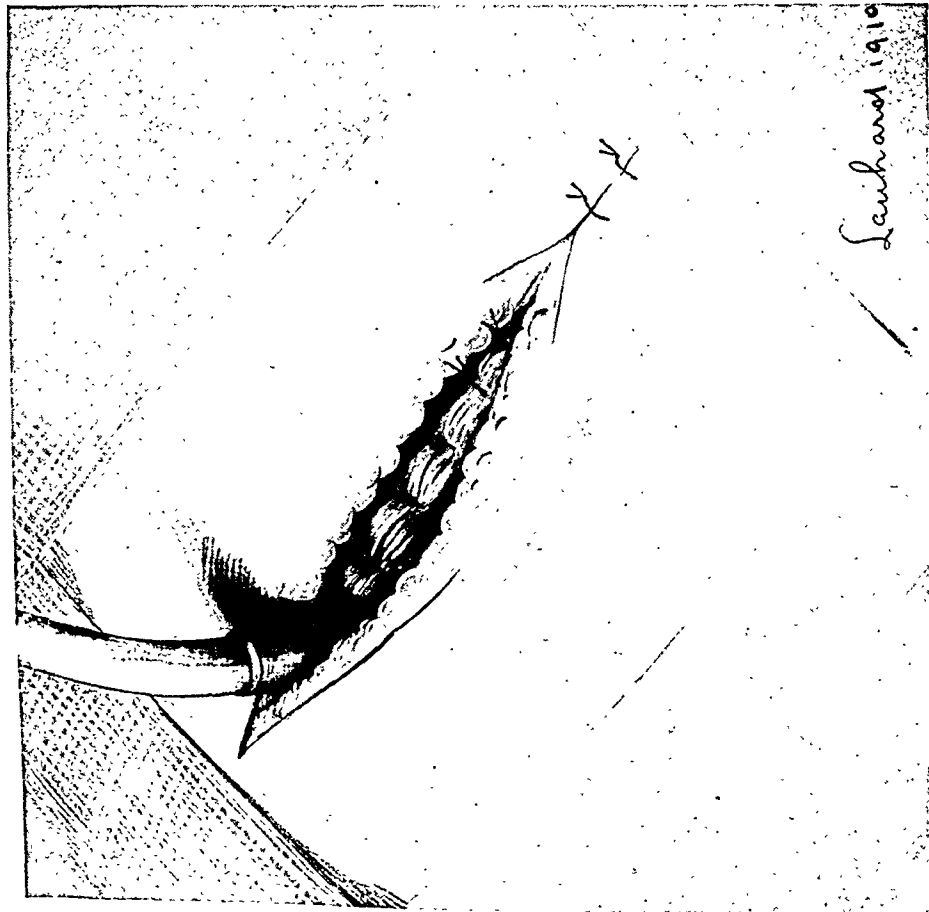


FIG. 9.—Layer suture of the parietal wound and tube at lower angle leading into bladder.

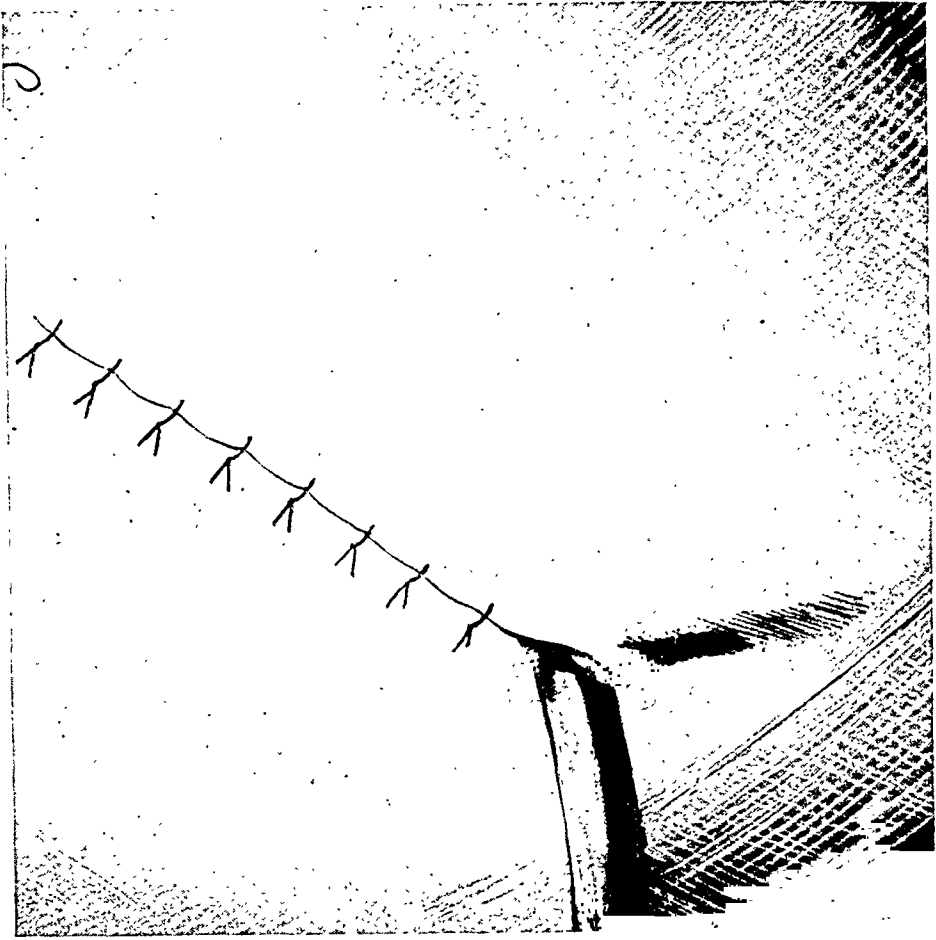


FIG. 10.—Drainage of superficial wound with gauze or rubber dam to suture line in bladder.

OPERATIVE TREATMENT OF BLADDER NEOPLASMS

5. Then, depending upon the position of the growth or growths, the bladder is incised either through its anterior, its posterior or its lateral walls. The incision should be gradually enlarged so that wipes can sponge up the little fluid that may be in the viscus. Sponging within the bladder should be reduced to a minimum. As the incision is enlarged the papillary growth will become evident, and it is immediately cauterized *in situ* with the electric cautery (hook) or with the Paquelin (hooked point). In cases of multiple growths each growth is separately burnt, and every suspicious spot is treated similarly. A too-extensive cauterization is preferable to a too superficial. If the papillary growth is so large that it can not be treated in this ideal manner it may be seized with a blunt ring clamp and delivered piecemeal till the pedicle is reached, when a Carmalt-curved clamp is placed across this and the cautery slipped between the clamp and the bladder wall. If the bladder wall is infiltrated a wide cautery resection of this area is carried out. If a ureter is involved in the infiltrated area it is left attached till this area is resected and then cut away from the resected portion at a distance from the growth. Thereafter it is implanted in a healthy part of the bladder just before the bladder wounds are sutured.

6. Having a rather deep cavity to expose, it is wise to use retractors of different sizes and lengths rather than automatic retractors,¹ so that all surfaces of the organ can be gone over readily, and none are covered except momentarily by the blades of the retractors. Again, to hold the organ well out of the body, clamps without *teeth* are applied to the bladder incision as it is being made. The use of clamps with teeth such as the Kocher, which produce minute perforations in the bladder wall, thus possibly producing implants, should be avoided.

7. Being satisfied that all the visible tumor or tumors have been destroyed our next efforts are directed against possible cell implants. These may be in the bladder incision, loose in the bladder or on the gauze protective packings about the organ. The incision which opened the bladder is carefully seared with the cautery proceeding from clamp to clamp in orderly fashion, each clamp being removed in turn as the cauterization proceeds. Then the table is lowered, and the whole wound is filled for about five minutes with alcohol, the bladder being allowed to slip back into its bed so that its cavity as well as the protective gauze is exposed to the effects of the alcohol which it is hoped will coagulate any potential cell implants that have broken away during the various manipulations.

8. After this thorough bath in alcohol the gauze protective packings are removed, fresh gauze being substituted. The bladder is sponged dry, and its incision is closed after making provision for suprapubic tube drainage. (It is at this stage that the ureter is implanted in its new place.) In closing the bladder a layer of plain catgut sutures is used to

¹ An automatic retractor in the parietal wound is essential and very helpful.

infold the charred edges of the incision, and over this a layer of chromic gut is applied to support the first layer.

9. The incision in the parietes is closed in layers, drainage with rubber dam or gauze to the bladder, both above and below the tube which enters that organ, completing the procedure.

From a consideration of the above points, I believe it will be agreed that everything that one can do to minimize the danger of implants has been employed, and it must be evident that such a thorough technic could only be carried out through an extraperitoneal approach. In infiltrating growths of the posterior wall involving or near the peritoneum one is perforce limited in one's activities, as the resection must include the peritoneum. This, however, is the only position in which the technic must be slightly modified and the alcohol flooding can not be used. In infiltrating growth involving the neck of the bladder total cystectomy is still "*sub judice*." In one case of this character in which I removed the bladder, prostate and vesicles, and who was shown to this Society some years ago, the patient lived over five years.

Whether radium should be used in the benign cases in which the high frequency method or the above operative technic is available, I believe should be answered in the negative. In operable malignant cases without or with moderate infiltration, I believe operation offers more than radium. In the advanced cases—and many cases of malignancy unfortunately fall into this group nowadays—radium has a very large field in which to demonstrate its efficacy.

TIBIAL TUBERCLE AFFECTIONS

REPORT OF SEVEN CASES

By RICHMOND STEPHENS, M.D.
OF NEW YORK CITY

THIS condition is usually referred to as Osgood-Schlatter's Disease, but should really be classed as an injury and not a true disease. The subject has been so well presented by Osgood, Schlatter, Dunlop and others, that it is unnecessary to go into a detailed description here.

Six cases of this lesion were seen in the Out-Patient Department of the Hospital for Ruptured and Crippled, between October, 1916, and April, 1917, demonstrating its rather frequent occurrence. The war prevented us from following these cases, but recently, while attempting to collect them, a case was seen which is here added to the series. The six original cases were adolescent boys and the recent one is a woman of forty-one years but the facts make us believe that it belongs to this group.

The etiology is not definitely certain but is, in all probability, injury either from a direct blow to the tubercle of the tibia or from strong contraction of the quadriceps femoris muscle pulling through the patella and patellar ligament. It has generally been considered an affection occurring during adolescence and is usually seen in boys. This fact is in favor of it being traumatic in origin for young boys are usually active and frequently injured. The injury may be too slight to be recorded or may be from frequently repeated mild blows or strains. It is reasonable to suppose that in active youths the very strong tendon attached to the tubercle up to the time of ossification may cause its separation and lead to a non-suppurative inflammation. In later life the same signs may be due to a fracture or periosteal tear followed by periostitis.

In this small series of cases four of the boys and the woman gave a history of trauma and the other two did not. There was nothing in any of the cases to suggest local disease or infection, but we feel certain that there is always some inflammatory reaction as in cases of traumatic periostitis.

In the adult patient there was a history of injury and the examination showed a definite point of tenderness over the tubercle with slight heat, redness and swelling. The X-ray examination was negative, as was also the Wassermann reaction. Even though there had been previous similar trouble it responded to simple treatment consisting of rest and strapping with adhesive plaster.

The accompanying X-ray pictures of some of the boys show various types of tubercles. Some could easily be considered as separate ossification centres, some as lips projecting down from the epiphysis and others

look as though they had been torn or pulled from the tibia. However, it will be noted that similar conditions are seen on the normal side and in some cases one might suspect that there was even more trouble on this side.

The treatment in all of the cases was rest and strapping and in practically all this was sufficient. One resistant case was put up in a plaster-of-paris bandage. I regret that the cases have not been followed longer but efforts to locate four of the boys have failed. The adult is still under observation but is markedly improved. Several cases have been reported that were treated by operation where the conservative treatment apparently was not sufficient or where the case had been considered more serious in character. Personally, I have not seen such cases and I have not found any reports which state that the prognosis of the final outcome is at all bad. Of course, it is conceivable that the duration of the disability might be shortened by operation, but it would seem to be practically unnecessary to subject a patient to such treatment.

CASE I.—I. A., schoolboy aged fourteen years. First seen October 21, 1916.

History.—About two years ago he twisted his left knee inward while playing basket ball. Had considerable pain and had to stop playing. Pain persisted for two weeks but he was able to get about with a limp. After this he only had pain on rainy and cold days. Six months later he had more pain and was told at a hospital that he had a strain but received no treatment.

Examination.—Came in with a limp, slight pain and a tender swelling just below the left knee. Examination revealed an enlargement about one inch in diameter over the left tibial tubercle which was tender but showed no redness or ecchymosis. There was no fluid in the joint and no limitation of motion. Examination of the right knee and leg was entirely negative.

X-ray shows a condition which might be interpreted to be a periosteal tear or a separation of a centre of ossification. (Fig. 1.)

Treatment.—Adhesive plaster strapping for two months and then a canvas knee-lacing which covered the joint and extended down about three inches below the tubercle.

Examination (March 1, 1917)—After four months' treatment the patient feels perfectly well and the knee appears normal.

March 1, 1920.—Efforts to locate the patient have failed.

CASE II.—J. D., schoolboy aged fifteen years. First seen October 31, 1916.

History.—Five years ago he was knocked down by a heavy truck and one of the wheels ran over his left knee. Wore a plaster-of-paris bandage for three months with the leg in extension. He was then well until eighteen months ago when he began to have some pain below and in front of the knee. The leg was said to be "weak" and there was a hard tender mass present. He was then treated with adhesive plaster strapping for about nine months without relief.



FIG. 1.—Case I. Left knee. Tubercle appears as separate bone fragment just below the tongue-like projection from the epiphysis

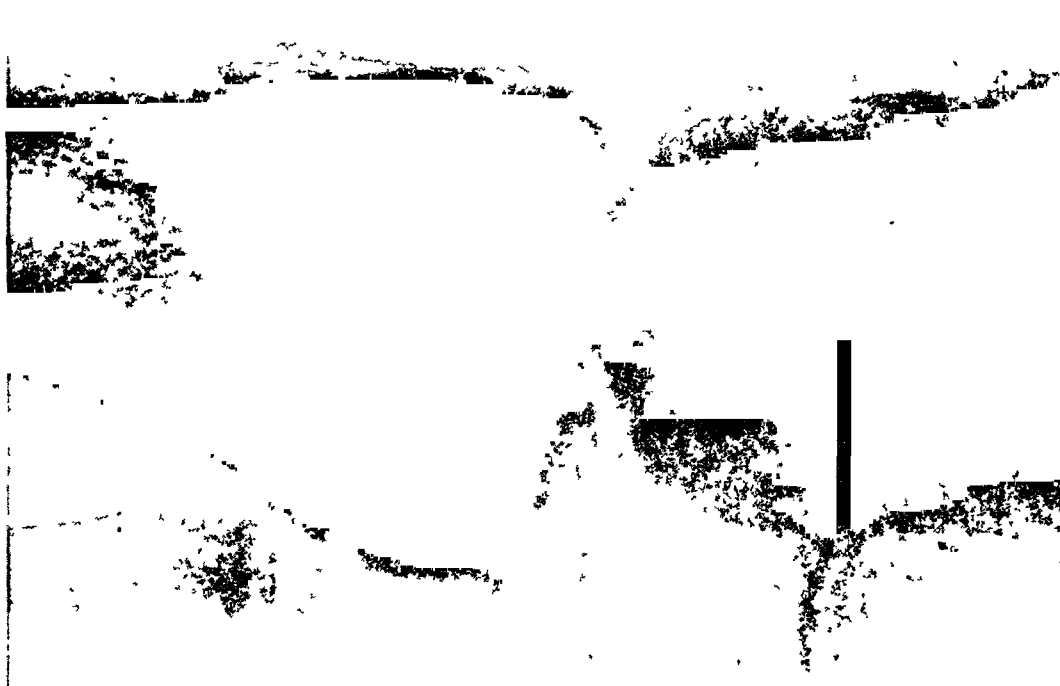


FIG. 2.—Case II. Left knee. Appears to be a long area in the patellar ligament near its insertion.



FIG. 3.—Case III. Left knee. Shows the tongue-like process from epiphysis, which is about the most frequent type seen.



FIG. 4.—Case IV. Right knee. Appears quite similar to the left.

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Examination revealed a tender swelling over the left tibial tubercle about one inch in diameter with no redness, heat, ecchymosis, limitation of motion or signs of fluid in the knee-joint. The right knee was negative. He claimed that the pain was worse during active exercise and especially on going up or down stairs.

X-ray appeared as a case of periosteal tear while that of the other knee was more like a simple projection at this point. (Fig. 2.)

Treatment.—Adhesive plaster strapping for about two months and then a canvas knee-lacing. He did not improve and would not

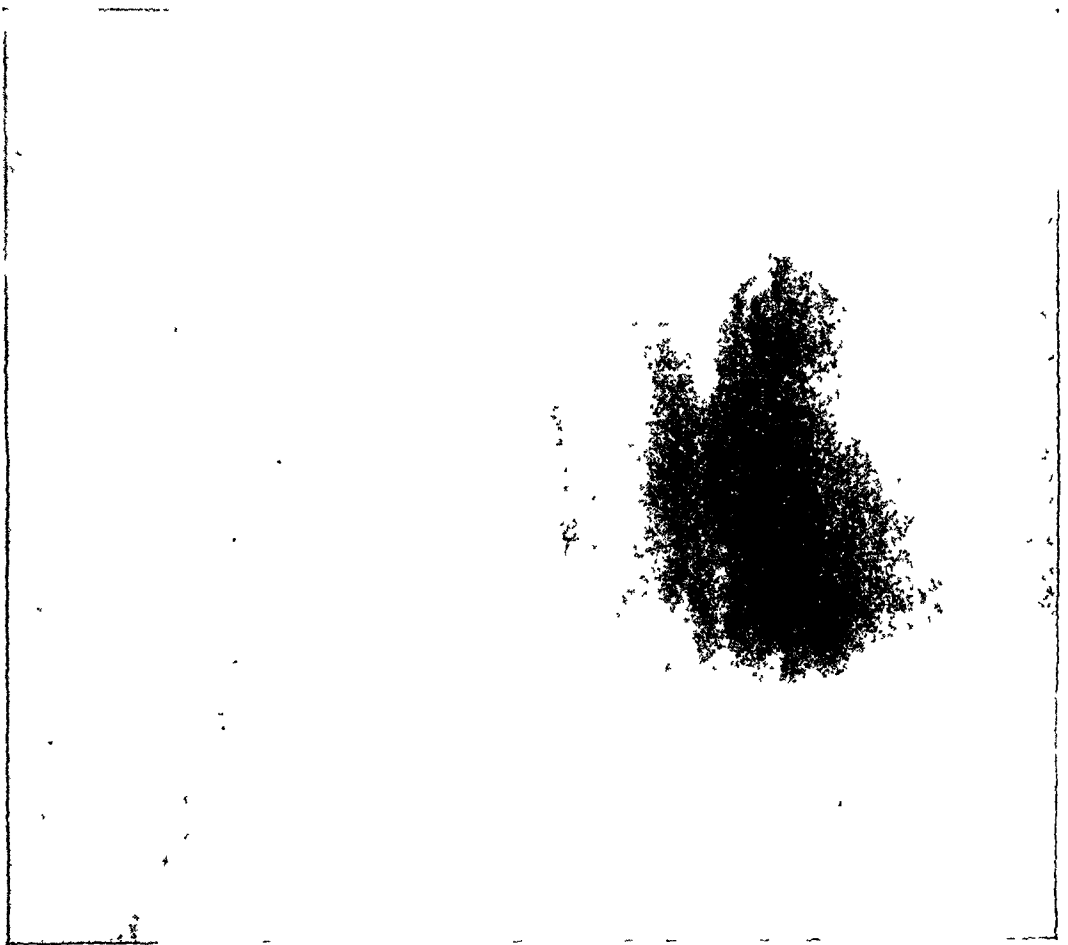


FIG. 5.—Case V. Right or affected knee. Showing area of ossification at point of insertion of patellar tendon, which is rather hazy in appearance.

try to rest the part, so we applied a plaster-of-paris bandage with the leg extended, for a month. We then returned to adhesive strapping and the lacing and he was improving but could only be followed for three weeks.

March 1, 1920.—Efforts to locate the patient have failed.

CASE III.—G. McC., schoolboy aged thirteen and a half years. First seen February 6, 1917.

History.—Definite injury denied but he says he often fell on his knees. One month ago he began to have some pain and noticed a swelling on the front of the left leg just below the knee. Severity has slowly but gradually increased. Two weeks ago he says he

could not fully straighten the leg because of pain and "stiffness," but it is now improved.

Examination shows a swelling one and one-quarter inches in diameter over the left tibial tubercle which is tender but not red, hot or ecchymotic. There is no fluid in the joint and no limitation of motion. On motion there was a soft grating sensation over the patellar ligament. He claims that the pain is increased by active exercise and especially on going up and down stairs. The right knee showed a similar swelling, but it was not tender or bothersome.



FIG. 6.—Case V. Left or unaffected knee. Showing very large and prominent tongue-like process from the epiphysis.

X-ray showed a lip-like projection down from the epiphysis and this was identical on both knees. (Fig. 3.)

Treatment.—Adhesive plaster strapping.

Examination (March 1, 1917).—Condition improving but patient could not be followed after this time.

Examination (April 10, 1920).—Patient says he has had no trouble since March, 1917, and now can only tell that the left leg was involved by the fact that the tubercle is slightly larger on that side.

CASE IV.—P. S., schoolboy aged fourteen years. First seen January 30, 1917.

History.—Denied injury. Four months ago began to have some

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pain just below and in front of the left knee. A few days later the same trouble started on the right side. Has been unable to kneel and has most pain when exercising or climbing stairs.

Examination.—A tender enlargement of bony hardness over the right tibial tubercle. No crepitus, redness, heat, limitation of motion or signs of fluid in the knee-joint. The left knee showed an identical condition except that there was less enlargement.

X-ray revealed a tongue-like process from the epiphysis on the left tibia which appears as though it had been fractured through the



Fig. 7.—Case VI. Shows apparently separate bone fragment or ossification centre at point of insertion of patellar ligament.

epiphysis into the joint. The condition appears almost the same on the right side. X-ray pictures about four months later show the conditions just the same.

Treatment.—Adhesive plaster strapping of both knees. There was no improvement during the first month, but four months later when the second set of pictures was taken the patient was practically well.

Examination (March 1, 1920).—Efforts to locate the patient have failed.

CASE V.—J. M., schoolboy aged fourteen years. First seen April 17, 1917.

History.—Injury denied. For the past three months he has had pain just below the right knee on the front of the leg when he kneels. There has been some slight swelling visible during this time. The condition has been stationary and he has not had any treatment.

Examination.—A tender swelling on the right tibia over the tubercle. No redness, heat, crepitus, limitation of motion or fluid in the joint.

X-ray.—A hazy appearance suggestive of a periosteal tear. (Fig. 5.) The left or normal knee showed a long pronounced tongue-like process from the epiphysis. (Fig. 6.)

This case did not return for treatment and all efforts to locate the patient since have failed.

CASE VI.—B. W., schoolboy aged eleven and a half years.

History.—Patient had pain in the region of the right tibial tubercle for one week. No history of injury. There was a swelling in this region which was hot and tender. The left side showed a similar swelling but it did not cause him any trouble.

X-ray.—Right knee showed the tubercle as a separate body apparently not attached to the tibia proper (Fig. 7).

NOTE (March 1, 1920).—A letter from the patient states that he was under treatment with adhesive plaster strapping for about nine months and that he has been well ever since, with the exception that at times in bad weather it "grows stiff and pains."

CASE VII.—V. D., housewife aged forty-one years. First seen November 1, 1919.

History.—Three years ago the patient fell and hurt her right leg just below the knee. The pain lasted about four weeks and she did not have any treatment. Four weeks ago the pain returned in the same place and she does not recall having injured the leg again.

Examination shows heat, redness and some swelling over the right tibial tubercle which is very tender. She says there is almost constant pain of a rather dull character. Wassermann, negative. X-ray, both knees negative.

Treatment.—Adhesive plaster strapping.

Examination (Feb. 28, 1920).—Patient is still under treatment, but is much improved. There is no swelling, heat or redness now, but the region over the tubercle is still tender.

CONCLUSIONS

1. Affections of the tibial tubercle are seen frequently during the period of adolescence, especially in males, but occasionally in adults.
2. They are inflammatory, non-suppurative, and due to injury.
3. The disability is rarely complete and the prognosis is good.
4. The treatment should be rest, protection and sometimes immobilization. Operation is only indicated in exceptionally protracted cases.

TIBIAL TUBERCLE AFFECTIONS

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HYSTERECTOMY IN THE LANKENAU (FORMERLY THE GERMAN) HOSPITAL*

REPORT OF ONE YEAR'S (1919) WORK INCLUDING THE WRITER'S EXPERIENCE WITH RADIUM IN UTERINE CONDITIONS DURING THE YEAR, AND REMARKS UPON THE PATHOLOGY: BY
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LANKENAU HOSPITAL

BY JOHN B. DEEVER, M.D.
OF PHILADELPHIA, PA.

THE year's (1919) work in hysterectomy at the Lankenau Hospital of Philadelphia comprises 130 operations, of which 46 were complete and 84 subtotal. Two deaths in the entire series yields a mortality of 1.5 per cent.

A complete hysterectomy was done for simple uncomplicated fibroids in 7 instances and in 14 for fibroids with one or more complications. In addition to these there were 10 cases of prolapsus uteri, with acute or chronic inflammation of the cervix, tubes and ovaries, necessitating a complete hysterectomy. The series also included 5 cases of carcinoma of the uterus, one of which presented extensive ulceration, gangrene and purulent infiltration at the site of radium treatment, by no means an isolated instance of this kind that has come to my notice. The one death among the complete hysterectomies was due to myocarditis.

Subtotal hysterectomy for fibroid was done in 84 cases, 12 being simple non-complicated and 72 complicated—the complications being salpingitis, tuboövarian inflammation, pyosalpinx, anomalously located fibroids, pregnancy, nephritis, endocarditis, etc.

In this series of 84 cases there was not a fatality. Malignancy was present in 2 instances, in 1 associated with carcinoma of the breast. Sarcoma was noted in 1 case. In 7 instances degeneration of the myoma had occurred, hyaline 6 times and calcareous once. Adenomatous polypi of the uterus, cervix or both were present 5 times.

The fatal case in this series was due to enterovaginal fistula, the result of radium treatment.

Total hysterectomy for fibroid or fibroids should be the better operation, particularly when the patient is near, at, or past the menstrual epoch, and especially when there is any doubt about the condition of the cervix or the endometrium. Were this the usual practice there would be less likelihood of subsequent carcinoma and a recurrence of the fibroid of the cervix, which I have seen, necessitating a difficult operation for its removal.

The operation I make in subtotal removal is amputation of the supravaginal cervix by a V-shaped incision, which leaves a wedge-shaped cavity in the cervix, into which cavity I implant the stump of the broad ligaments, the operation being completed by bringing over the stump and

* Read before the American Surgical Association, St. Louis, Mo., May 3, 1920.

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stitching to the posterior surface of the cervix the reflected flap of the peritoneum carrying the bladder with it, the latter being the first stage of the operation.

In total removal of the uterus I free the upper portion of the vagina with the uterus, apply a right-angle clamp to the vagina and amputate with the actual cautery, closing the vagina by continuous suture carried around the clamp; clamp removed and ligature secured. The stumps of the broad ligament are fixed to the vaginal stump and all covered by pulling the reflected peritoneal flap backward and over the stump and stitching to the posterior wall of the vagina. This makes an extraperitoneal operation practically, and thus avoids a possible chance of infection from the vagina. I practice this operation with satisfactory results in a percentage of cases of complete prolapse of the uterus and the vagina or of the vagina alone.

In large soft myomas, which at times make the uterus look so much like a pregnant one, I have no hesitancy in incising through the anterior wall of the uterus, thus making sure.

My confidence in the operation of transperitoneal hysterotomy is so great that I have equal confidence in opening the uterus to the light of day under the above-mentioned conditions. The other and many complications arising in connection with this form of surgery are so familiar to you all that I will not discuss them, nor is it necessary for me to say that submucous fibroid of the uterus, that cannot be safely removed through the cervix, is best and most satisfactorily handled by making a transperitoneal hysterotomy.

When the fibroid uterus is very large or the fibroid grows chiefly from the supravaginal cervix or out into the broad ligaments, I frequently am able to shorten the operation as well as have less blood lost by amputating the supravaginal cervix from side to side, from behind forward or splitting the uterus vertically, etc. The uterus amputated, the cervix grasped and held steadily with a vulsella forceps is readily removed.

The greatest danger of complete hysterectomy is, of course, the risk of injury to the ureters. But this can be avoided by exposing the ureters well back in the broad ligament and tracing them forward to the bladder, so that they are constantly in view when tying off the vessels. But should accidental lateral ligation of the ureters occur, as it may even to the most expert operator, it manifests itself promptly and can be corrected.

Myomectomy for the subserous pedunculated fibroid is a very satisfactory procedure, but the submucous type, provided it does not present or project into the cervix, is to my mind better attacked by transperitoneal abdominal hysterotomy. For large-sized intramural fibroids also, I believe, a subtotal or complete hysterectomy to be much less momentous, from the standpoint of immediate and of secondary bleeding, than myomectomy. So many of this class of patients are highly anæmic that there is danger in any operation that is attended by even

a minimum loss of blood. Furthermore, it is my experience that most of the women with fibroid uterus are sterile; so the argument that some few become pregnant after myomectomy does not affect my view, although I admit it to be a debatable one. I have known a few instances of recurrence of fibroid in a myomectomized uterus; therefore, this possibility must be reckoned with.

A full discussion of any one point mentioned would take more time than the rules of the association permit. I have therefore contented myself with merely touching upon them. If I succeed in instilling the necessity of caution as to the use of radium into the minds of those present I shall be satisfied.

Radium in Uterine Surgery.—During the same year (1919) 58 cases were treated with radium, 39 for carcinoma of the cervix, 12 for carcinoma of the uterus, 5 for myoma uteri, and 2 for chronic endometritis. One death makes the mortality figures about the same as in the operated series. While, of course, figures standing alone are not convincing, I believe they speak favorably for surgery in this instance. I emphasize this the more especially as I am so often confronted with the destructive action of radium, such as gangrene, ulceration and purulent infiltration at the site of the application, that I must necessarily hesitate to sound its unqualified praises.

With the introduction of any new therapeutic agent there very naturally arises the hope that the solution of a perplexing problem is at hand. Radiation in the treatment of disease of the cervix and uterus has proved no exception to this rule. More or less enthusiastically, usually more, during the past several years the röntgenologist and radium therapists have been so loud in their praise of their results that the protesting or opposing voices have been in danger of being drowned. It is not, however, as a total opponent to radiation in the treatment of these diseases that I ask to be heard at this time, but rather for the purpose of introducing a different note, perhaps in a lower key, into the melody.

First and foremost I believe that in the decision for or against the use of radium the voice of the surgeon should be accorded equal if not greater weight than that of the radiologist. Every fair-minded surgeon is free and indeed glad to acknowledge that radium can control uterine bleeding, in fact arrest it; and that together with the X-ray the size of intramural and submucous fibroids can be reduced if not entirely dissipated. But there remains to be considered the effect of the presence of mutilated and destroyed tissues. Is not a woman better off without a uterus or with only the neck of one than she who harbors an organ that has been burned to death? Is not this a rather undesirable tenant of the human body? Better an empty house than an undesirable tenant. Moreover, radium treatment for fibroids has in four instances that have been recently brought to my attention been the direct cause of death, the

fatal outcome being due to peritonitis in one case, rectovaginal fistula in another and extensive pelvic suppuration in the remaining two.

It is my practice to make a transperitoneal complete removal of the uterus in all cases of carcinoma of the fundus and in very early carcinoma of the cervix. I am sure this is the better practice than is the use of radium in this early stage. Recalling the free lymphatic supply of the cervix and that the lymphatics pass through the broad ligaments, is not this a better surgical procedure than to apply radium? Radium should, in my judgment, be used only in the late cases, those in which lymphatic involvement has gone beyond the reach of the knife. In the latter class of cases, radium properly used without doubt prolongs life, but that it cures, I doubt. I have never seen a case of advanced cancer of the cervix, where the entire cervix has been involved, cured by radium. I have, under the latter circumstances, seen the cervix under the administration of radium practically returned to apparently normal conditions, but, sad to say, followed by recurrence in a comparatively short time, which recurrence in my experience is seldom benefited by the further use of radium.

Even in the non-malignant uterus with free hemorrhage, where in the absence of adnexal complications radium has a recognized field, the cases should be judiciously selected. Menorrhagia in a young woman is a serious matter and requires careful study. Very often hysterotomy is the better method for arriving at a correct diagnosis and determining existing pathology, and is indicated rather than curetting through the vagina or the application of radium. Too often, I fear, the specialist may yield to the persuasion of his clients and administer radium to relieve the inconvenience of menstruation prolonged a day or two beyond the usual time, unmindful or perhaps ignorant of the fact that the indiscreet use of radium in a young woman suffering from menorrhagia or metrorrhagia is liable to lead to sterility. It is against such illegitimate use of the substance that I would register a most serious protest.

While in some cases of chronic endometrial inflammation radium has proved useful, I believe here also it should be used only after all other recognized means of treatment have failed.

Very often the differentiation of quiescent appendicular inflammation and latent non-palpable tubal disease can be made only by opening the abdomen and inspection; therefore, in the presence of this uncertainty as to the propriety of using radium the knife is the better arbiter in the matter.

In a number of cases of purulent leucorrhœa, radium has failed to be of value, and while curetting, cauterization of the endometrium or the application of iodine, etc., may be efficacious, there is little chance of these measures proving so on account of the probable involvement of the tissues adjacent to the endometrium, so that removal of the uterus either by the transperitoneal or the vaginal route offers the only hope of cure.

Since the demonstration of normal cyclic changes in the endometrium, much confusion regarding hypertrophy and hyperplasia of the endo-

metrium has been cleared up. The pathological diagnosis of hypertrophic and hyperplastic endometritis is made very much less frequently than before. That there is, however, a type of change in the endometrium consisting of both hypertrophy and hyperplasia is unquestioned, but its frequency is comparatively low. Irrespective of changes incident to the menstrual cycle, a few uteri will show a shaggy, thickened endometrium, sometimes pale, often with small areas of congestion or even hemorrhage. This fringy condition is very often not universal but focal, and is especially seen over myomata projecting into the uterine cavity. Histologically the glands are larger, increased in apparent number, and often-times appear in marked corkscrew form. Excess secretion and rarely red blood-cells are seen in the lumina of these glands with congestion of the interstitial tissue.

Cellular infiltrations, if due regard be paid to the menstrual cycle, are relatively uncommon. They may consist of plasma-cells and inflammatory lymphocytes. At the menstrual period cellular infiltrations in which the polymorphonuclear leucocyte appears in goodly number, are, of course, the rule. Cystic changes are also occasionally seen in the hypertrophic endometrium; the cysts are microscopic and may be empty or contain varying amounts of *débris*.

Chronic endometritis in the sense of fibrosis and round-cell infiltration is one of the rarest of changes observed in our specimens. In several instances it was definitely associated with long-standing inflammatory processes in the adnexa. With the average run of specimens the number of times an endometritis can be diagnosed is very small. Those in which acute endometritis varying from mild to severe, almost phlegmonous type occurs are constantly associated with acute inflammations of the adnexa.

The subject of myopathic hemorrhage has received considerable attention and quite extensive pathological and histological investigation. The consensus of opinion at the present time states that the hemorrhages are due to functional disturbances of the ovary and associated ductless glands. Certain it is that definite, constant pathologic anatomic changes, either in the endometrium or ovary, are conspicuous by their absence in certain cases of uterine hemorrhage even when constitutional causes, such as incompetent myocardium, anæmia, etc., can be ruled out. This explanation in a way avoids the issue; it takes the place of explanations such as apoplexia uteri, endometritis senilis, mucoid degeneration of muscularis, etc., which were in vogue until investigated and found wanting.

The ovarian functional explanation is one which presents far more difficulties of proof or disproof than the others. Anspach, from careful histological studies, concludes that certain of these hemorrhages might be explained by a failure of the usual sclerotic change following childbirth. Reasoning by analogy the elastica present in the uterine wall may

be expected by the very nature of the normal changes through which this organ passes during menstruation and the child-bearing act to play a very considerable part in the physiology of the vessels. Failure of this tissue to functionate may easily lead to otherwise inexplicable bleeding.

Of the action of radium on tissues two striking changes have come to notice and on which all authors agree. They are an increase of connective tissue and a decrease of parenchyma. The most complete studies have, of course, been made of its effects on carcinoma. The connective-tissue overgrowth presents the most striking picture, but recent investigations by Alter, for example, show that the destruction of parenchymatous cells is the most important. The chromatin substance of the nuclei displays a great sensitivity toward the rays of radium and undergoes a deep-seated chemical change. The final result is a destruction of the nucleus and a scattering of the chromatin. The connective-tissue increase seems secondary, its purpose to replace the destroyed parenchyma. There is, apparently, no stimulation of this tissue to active growth by radium.

Two specimens have been especially studied in this laboratory at periods varying from one week to five weeks after radiation. The organs were removed surgically. The first specimen was that of a squamous-cell carcinoma of the cervix. Great destruction of carcinoma cells was evident, with intense congestion and polymorphonuclear and other cell infiltration. The destructive effect was manifest through the length of the cervical canal and extending into the wall approximately one-half inch. Beyond this living carcinoma cells were plentiful. The other patient presented a continuous small amount of hemorrhage and was suspected of having carcinoma of the fundus. The uterus was very soft and boggy and the entire uterine cavity showed an intense inflammatory reaction, with mucosa and considerable muscle immediately about the site of the radium necrotic and deeply ulcerated. The remainder of the uterine mucosa also showed ulceration extending from a part to a whole of this structure. Beyond the necrotic part, and extending throughout the entire wall of the uterus, was an extraordinarily violent inflammatory reaction. Sections from other parts of the uterus showed the same oedema, pus-cell infiltration, hemorrhage and congestion, but to a less degree. Tubes and ovaries also gave evidence of acute inflammatory reaction, but to a still less degree. A small amount of fibrin was present on the peritoneal surfaces. Reparative processes were practically entirely absent. No carcinoma was found.

There can be no doubt, therefore, of the intense destructive activity of radium. If the dose can be so graduated to destroy endometrium when this is desirable, its field of usefulness is, of course, established. When, however, its destructive properties are not controlled or controllable, its potentialities for harm are limitless.

Since the endometrium in the cycle of its normal functions under-

goes marked anatomic changes, it follows that for intelligent interpretation of anatomic pictures it is essential to consider the data of menstruation with the specimen of pathologic report. The age of the patient and the number of pregnancies and childbirths is also important, for these factors influence the musculature, blood-vessels and interstitial tissues. Especially is this important in the final judgment in cases of so-called myopathic hemorrhage, when all constitutional factors have been ruled out and there remains a uterus with no lesions discoverable by ordinary means.

Much of the confusion attending these diagnoses and many of the coincident questions, for example, can a hypertrophic endometrium bleed? will then be cleared up. Then the effects of therapeusis, whether by radium or surgery, can be better estimated.

NOTES ON THE NON-OPERATIVE TREATMENT OF FRACTURES *

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Introduction.—We have been much impressed lately with the enormous literature that obtains on the operative treatment of fractures. Almost every medical journal contains some related article on this subject and, although undoubtedly the non-operative treatment is still the method of choice in fracture cases generally, it is hoped that such reports as this may tend to confirm the followers of this method in the propriety and advantages of their work. Certainly they follow the more accepted path. And yet we do not lose sight of the fact that from the time of Owen Thomas on, the open reduction of certain fractures has been advised. We feel, however, that at the present time the brilliant work of Arbuthnot Lane has swung the pendulum too far and that unnecessary risks are now being taken in operating upon fractures easily and possibly better treated by the closed method.

If there is any one branch of medicine in which the recent experience gained by observation of battle casualties has been of distinct value it is that concerned with the care and treatment of fractures. And that experience, which by force of circumstance was enormous, brought out certain principles of treatment that are applicable to civil fractures whether compound or not. The chief lessons learned were: (1) The success of mobilization in the treatment of infected joints, and (2) the value of traction in the care of fractures generally. With the first of these lessons it is not our concern in this present paper.

The principle of traction in fractures is by no means new. Indeed, it antedates the more modern conception of the operative treatment so urgently supported by Mr. Arbuthnot Lane. Yet in recent years, traction had fallen somewhat into disuse through the brilliancy of a few operative reductions in which mechanical splinting was used and the general impression that immediate reduction and fixation in plaster gave better results. Certainly in the medical schools of the present day, or rather in the years immediately preceding the war, students were not much impressed by their instructors with the value and efficacy of slow, continuous traction. To those to whom the war gave the opportunity to study fractures in vast numbers, the results obtained by traction at first seemed almost marvellous, especially when the simplicity of the method was appreciated. It was soon found that traction in the direction of an extremity would in almost every incidence, if of sufficient amount, bring displaced bones into alignment. Accessory padding or lateral pulls were unnecessary, since fascial planes and neighboring muscle bellies, when

* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Mass.

made taut, soon brought the displaced fragments into alignment, no matter what the deformity. It is doubtless true that in the battle casualties considerable bone was often lost, so that this might be considered as making the realignment of fragments more easy to obtain.

A further observation, by no means new, but now perhaps best emphasized, was the malleability of callus at late periods. Thus, a badly deformed fracture of the femur as late as three weeks or even longer, and with visible callus formation and shortening, if submitted to sufficient traction could be pulled down to full length and good alignment obtained. Evidence of the elasticity and malleability of callus formation is presented by Sinclair,¹³ Blake,² and Bowlby,³ who have written that fractures of the femur twelve weeks after injury, when made ambulatory with splints, shortened considerably. Sinclair, therefore, purposely gave his cases with fractures of the femur from $\frac{1}{2}$ to $\frac{3}{4}$ inch lengthening before making them ambulatory.

Since this evidence is not yet thoroughly appreciated, it seemed that examples of its application to civil surgery might be of some value in making the use and value of traction more widespread and of diminishing the number of open operative reductions in which the added risk of anaesthesia, sepsis, and mechanical failure are always present. It would seem only wise to try the simplest procedure first, especially when its efficacy is proved. The first case is presented as an example of the efficacy of traction even when applied late in the healing of a fracture and is cited in preference to other cases because of the divided opinion as to whether operative or non-operative treatment should be used in this very instance. The second case is presented as an entirely different type of fracture in which operative methods of reduction are not uncommonly applied, but in which both this case and the evidence presented in the literature demonstrate the success of non-operative methods.

CASE I.—*Fracture of right femur*, S. S., Peter Bent Brigham Hospital, No. 24214 (Surg. No. 12100), male, aged thirty-five years, married, two children; occupation, painter and contractor.

History.—Born in Russia, has always enjoyed good health. No history of serious illness, accidents, previous operation, nor chronic disorders. Present weight is 135 pounds. Admitted to Peter Bent Brigham Hospital March 19, 1920, complaining of a sore right knee. Four weeks before admission (February 20th), while walking along a corridor, stubbed his left great toe on a loose piece of moulding and fell forward, striking on his right knee. The knee was painful and locomotion impossible. He was carried to a nearby hospital where an X-ray plate was taken and he was told there was no fracture. He was carried home and remained in bed ten days, the right knee being very sore and motion practically impossible. But as he thought the bone was not broken, he attempted crutches on the tenth day (March 4th), and although suffering considerably was able to go to his shop. While there, forgetting his injury, he sud-



FIG. 1.—Case I. Fracture of shaft of femur; condition at end of four weeks, lateral view.



FIG. 2.—Case I. Antero-posterior view.



FIG. 3.—Case I. Six days after application of adequate traction; lateral view.



FIG 4 —Case I. Six days after application of adequate traction, antero-posterior view

denly tried to stand up without his crutches, had very severe pain in his knee and collapsed on the floor, although he broke the fall as best he could. He was then taken to another hospital where his leg was carefully examined and, although he asked for X-ray studies, none were taken, as they told him there was no fracture and such studies were unnecessary. After remaining in bed ten days he became dissatisfied and went home (March 13th). Six days later, after suffering considerable pain, he came to this hospital (March 19th).

Examination.—A well-developed, healthy appearing young man lying in bed with his right knee slightly flexed and resting on a pillow. The general physical examination revealed no pathology beyond the local lesion in the right knee. The left leg was perfectly normal and the knee jerk and ankle jerk within normal limits. The right leg was held slightly flexed at the knee. There was a distinct swelling about the knee, beginning just at the tibial tubercle, and extending well up beyond the epicondylar region. There was some redness of the skin and fine excoriations apparently due to the application of iodine. Palpation revealed increased density of the swelling which was fusiform in shape, and apparently above the joint proper in which no excess fluid could be demonstrated. Moreover, the swelling was mostly anteriorly and it seemed as if there was an anterior bowing of the femur in the epicondylar region. No abnormality in the popliteal vessels could be demonstrated, and no nerves seemed to be interfered with. Abnormal mobility and crepitus could not be elicited, but motion of the joint was painful and limited.

With the history of trauma four weeks preceding, the angulation, and the swelling which we took to be callus, a diagnosis of fracture was made and radiographs (Figs. 1 and 2) revealed a T fracture, the transverse line being in the epicondylar region and the vertical line lying between the condyles and entering the joint. There was little separation of the condyles and, though more marked anterior bowing, the fragments seemed to some extent impacted, and the newly formed bone of the callus was barely demonstrable.

Treatment.—The case was presented at rounds where a lively discussion ensued as to treatment. The majority of observers, comprising the staff and visiting surgeons, believed that open reduction was necessary, and there was much debate as to the length of time after injury that callus remained malleable. Doctor Harvey Cushing cited Sinclair's experience that even as late as twelve weeks in femur cases shortening occurred with weight bearing, presumably due to elasticity in the callus. Our own experience led us to hope that in this case even such a large and definite callus might be moulded by traction. The advisability of using a Steinmann pin or Ransohoff tong for traction was brought up, to which the objections were raised that in the first case the insertion of the pin might separate the condylar fragments, and in the case of the tong, the application at exactly the right points on the lateral surfaces of the

condyles, in order to get posterior pull on the lower fragments, was extremely difficult. Moreover, both were to some extent operative procedures, and, though indeed slight, carried the added danger of sepsis. In any actual operative interference the danger also lay of freeing the impaction and thus suddenly allowing the gastrocnemius to exert its pull, thus converting an unusual deformity in lower femur fractures into the common but even more difficult type for treatment where the lower fragment is pulled posteriorly. We suggested that while the case still remained under debate, simple glue extension be used. The danger in this form of traction presented itself solely because of the possibility that the vertical line of fracture may have run into the insertion of the crucial ligaments and that traction below the knee might, therefore, separate joint surfaces and pull off what attachments of these ligaments remained intact at their femoral source.

This plan was temporarily accepted (March 20th) and glue extension was applied to the lower leg from ankle to knee, the leg supported in a Hodgen splint suspended from a Balkan frame, about fifteen pounds of weight attached for traction, the foot of the bed elevated and slings so arranged below the leg and thigh that the line of pull was in slight flexion. For about twenty hours the patient complained of pain in the knee, but thereafter was very comfortable, more so than he had been since the injury. The anterior bowing in two days was markedly diminished, and when control plates (Figs. 3 and 4) were taken six days after the application of traction (March 26th), the reduction to perfect alignment had been accomplished. The next day the Hodgen splint was removed and the leg placed on a pillow with two pounds of extension only to assist at immobilization. Callus now was clearly visible and the danger of a posterior displacement we thought passed. The swelling about the site of the fracture greatly diminished, the skin became wrinkled, and all pain disappeared. Motion in moderation elicited very little pain.

A week later traction was discontinued, as six weeks had already intervened since the injury, and we felt the fragments would not change. However, X-ray studies on April 9th showed that the anterior bowing had partly recurred (Fig. 5) and traction was again applied for a week, when the fragments were again found to be in good alignment (Fig. 6) (April 16th). After another week the patient was gotten up and given crutches, but bearing considerable weight on his fractured leg. Motion at the joint satisfactory, full extension, and over 90 degrees flexion. He was told to begin to discard his crutches.

Discussion.—The atypical deformity in this case is explained by the mechanism of the force applied during the injury and by the fact that the fracture was probably impacted and never loose. Had it been a loose fracture, the lower fragment would certainly have been pulled into the popliteal space. The vertical fracture which ran into the joint added



FIG. 5.—Case I. Recurrence of bowing upon discontinuance of traction six weeks after fracture was sustained.



FIG. 6 —Case I. Correction of deformity secured by resumption of traction.



FIG. 7.—Case II. Separation of lower epiphysis of femur, lateral view.



FIG. 8.—Case II. Separation of lower epiphysis of femur; antero-posterior view.

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another interesting feature. When first seen, the fracture was four weeks old and a very considerable callus was palpated. There certainly seemed to be union. The observers who advised open reduction felt that the amount of union was too great for simple traction and also proposed the possibility that if traction could loosen the angulation it might pull the ends apart and thus create an even less desirable situation with the lower fragment pushing down into the popliteal space. Further, the vertical fracture line ran close to the tibial spines and it seemed possible that traction might separate a tibial spine already involved in the fracture line.

Personal experience with traction in cases of fractured femora during the war led us to believe that even after four weeks much could be done to correct the existing deformity without endangering the joint or over-correcting the position. The plasticity of callus up to a late stage in its healing is an old story, recently emphasized by the brilliant work of many surgeons during the war whose methods of applying traction and whose carefully founded belief in the efficacy of this method are now well known. The work of Sinclair, Blake, Pearson, and others during the recent war needs no discussion here, and this case is reported merely to add to the evidence that their methods are equally applicable in civil as well as in war surgery, and to stimulate others to abstain, when possible, from the more dangerous methods of open operative reduction.

CASE II.—*Separation of lower epiphysis of femur*, F. P. B., Peter Bent Brigham Hospital, No. 23928 (Surg. No. 11964), male, aged fourteen years; occupation, school; seven brothers and three sisters living and well.

History.—Born in Boston, general health always good, pneumonia five years ago, no previous accidents or operations, weight ninety-three pounds. Admitted to the Peter Bent Brigham Hospital the evening of February 22, 1920, following an accident while coasting. Shortly before admission, while coasting down a steep hill, lying supine on his "flexible flyer," he turned out sharply to avoid a man, and his sled slued sideways and ran him side-on into a brick wall, striking against his right side. The right leg was hanging over the edge of the sled and was hit by the wall, therefore, on the outer aspect of the knee. Following the accident he tried to walk, but it would not support him, although it could be freely moved and there was little or no pain. Because of this, he was accused by his friends of faking. However, he was carried home and then taken to the hospital, which was near by, on a sled.

Examination.—Physical examination in the Outdoor Department showed a very healthy appearing, well-developed and fully conscious boy with no abnormalities or disabilities beyond the local condition in the right leg. The right foot was everted, the patella entirely displaced to the external lateral aspect of the leg, and there was deformity with considerable swelling at the knee. The lower

leg was to some extent displaced anteriorly and externally on the femur, and the lower end of the femoral shaft could be felt in the popliteal space posteriorly. Curiously there was very little pain and motion was surprisingly free, although the leg felt flail-like and moved easily in abnormal directions. Gentle manipulation revealed a grating sound and without an anæsthetic manipulation was continued and a partial reduction of the deformity obtained. The leg was then placed in a pillow splint and the case admitted to the house.

The next morning the deformity described on admission to the Outdoor Department was still present. There was a diffuse swelling about the knee with a concavity just above the knee on the anterior-external aspect due to the external and anterior displacement of the leg on the thigh. Motion had now become limited and quite painful. Radiographs (Figs. 7 and 8) showed a separation of the epiphysis with dislocation of the lower fragment anteriorly and externally.

Treatment.—It was decided to attempt reduction under anæsthesia (gas-oxygen). When anæsthesia had been induced the foot was held between the operator's chest and his right elbow in order to get traction, thus leaving both hands free to deal with the local manipulation at the line of fracture. The patient being held by assistants, traction was exerted, the distal fragment pushed down and moulded into position by the operator's hands and then the knee sharply and fully flexed. The deformity had been reduced, but a suspected danger appeared, for the foot suddenly became white and no pulse could be made out in either anterior or posterior tibial arteries. At once the leg was extended when the foot became pink and full circulation returned, also the deformity to some extent. However, a second manipulation gave us what appeared to be perfect reduction without any evidence of the artery being pinched. A plaster cast was then applied to maintain the position of acute flexion.

The next day radiographs (Fig. 9) were taken to control the position and showed accurate apposition of the fragments, and from this time on convalescence was uninterrupted. February 25th the cast was cut away over the condyles for observation and to relieve pressure; March 9th, the fifteenth day after reduction, the cast was bivalved, the leg removed from the cast, and motion begun; this was painful at first, but was indulged in daily, and March 18th the cast was discarded and baking, massage, and active motion begun. Control radiographs taken March 15th showed no change in the position obtained at reduction. March 27th, thirty-three days following reduction, the patient was discharged, using crutches, bearing considerable weight on the leg, but with still some impairment of full extension.

Since discharge he has visited the Outdoor Department frequently, and some two weeks after leaving the hospital the use of crutches was discontinued. Radiographs taken April 18th (Figs. 10 and 11) showed that the fragments were still in good position. He was last seen there May 18th; at that time he was not using

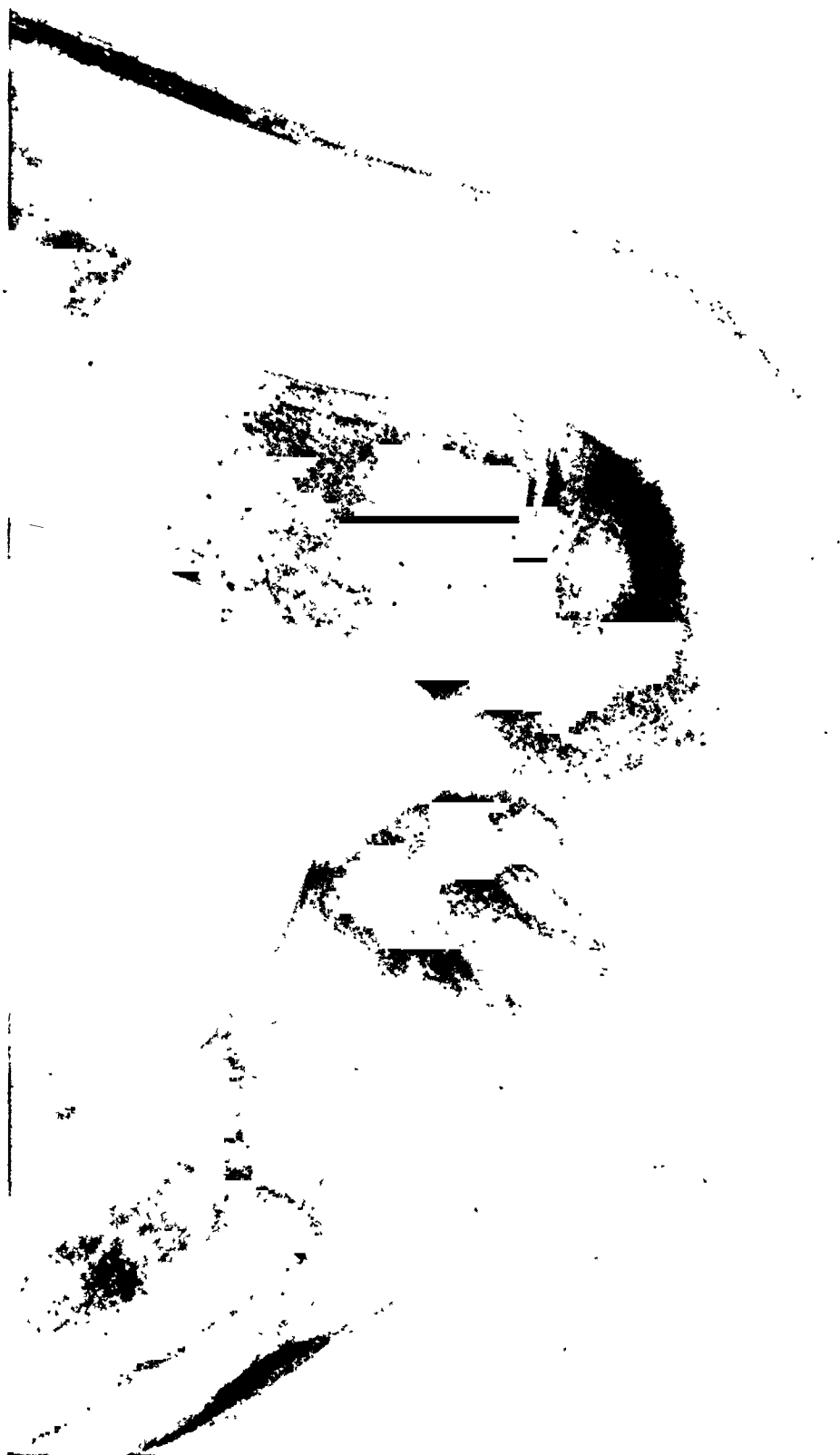


FIG. 9.—Case II. Reduction of epiphyseal fracture by acute flexion of knee.

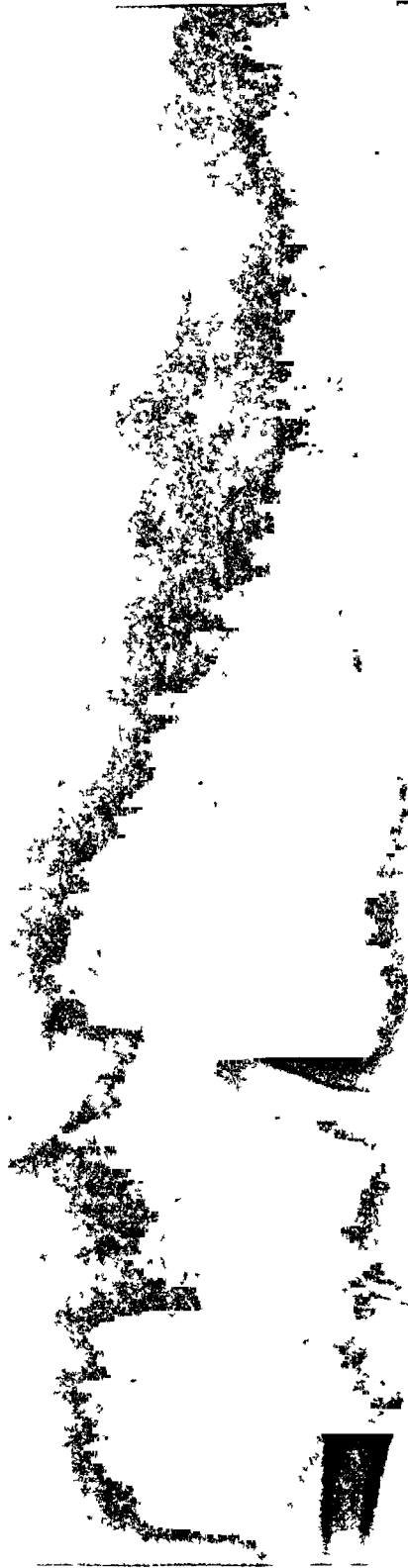


FIG. 10 —Case II. Condition of epiphyseal fracture after six weeks of treatment, antero-posterior view.



FIG. 11.—Case II. Condition of epiphyseal fracture after six weeks of treatment, lateral view.

crutches, full extension and almost full flexion were present in the knee-joint, he walked without a limp, and as far as subjective discomforts, complained of nothing abnormal. Palpation still revealed some callus.

Discussion.—Before taking up the methods of reduction of such fractures, it would seem wise to discuss the deformity in this case in relation to the force applied. Thus, in this case the force was apparently applied to the knee from before backwards, downwards, and inwards, and yet the deformity was towards the line of force. We have interpreted this as due probably to subsequent manipulation, though some peculiar application of force through lever action may have been present. However, it must be understood that the common deformity (Hilgenreimer⁷) is an anterior displacement of the epiphysis. The reason for this is probably because the origin of the gastrocnemius muscle is from the lower end of the diaphysis, not from the epiphysis (Drew⁵). Thus, once the epiphysis is loosened, no matter what the direction of the force, the gastrocnemius will eventually pull the lower end of the shaft into the popliteal space and leave the epiphysis anterior.

There are reported in the literature about 220 cases of this lesion and with the reports the methods of reduction vary between non-operative and operative methods. Among the operated cases, amputations and joint resection were done chiefly for compound fractures (MacAusland⁹), but open operation is also advised as the proper method in simple cases; MacAusland,⁹ Kahn,⁸ Demarest,⁴ Binney and Lund.¹ Hilgenreimer⁷ and Russell,¹² reporting separately a total of 214 cases, advise closed reduction and the putting up of the limb in mild or acute flexion for the simple cases. This policy would seem to be the wisest and there appears to us no good reason why such lesions in relation to the knee-joint should require operation more frequently than similar lesions about the elbow-joint. Our own case may have been a particularly simple one, but a review of the literature reveals that the deformity in this case is similar to that most frequently reported. Furthermore, such a study also reveals the fact that after reduction the position of mild or acute flexion is sufficient to maintain the position acquired in the reduction. Cases in the literature which have required reoperation because of inability to maintain the position acquired by manipulation were not, as a rule, put up in flexion. The after-care of such cases necessarily is endangered only by too long immobilization, fixation in flexion resulting in a stiff knee. To combat this, early removal from the acutely flexed position, depending somewhat on rapidity of callus formation, is indicated. We feel it is safe to advise reduction and fixation in the flexed position in all simple lesions of this type and believe that open operation is unnecessary and contraindicated by a study of the cases already reported.

It is hoped that the exposition of such cases that might have come into the category of fractures best treated by open operation, but demonstrated

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here to have been successfully treated by closed methods, will stimulate others to give the closed method a fair trial before resorting to the more dangerous and complicated method of operation.

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EXSTROPHY OF THE BLADDER IN THE FEMALE

REPORT OF A CASE SUCCESSFULLY OPERATED BY THE EXTRAPERITONEAL METHOD

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THERE have been so many and ingenious operations devised for the cure of exstrophy of the bladder that any further contribution to the operative technic would seem superfluous. However, in looking up the literature of this subject, I find that the very few successful operative cures were mostly in male subjects. I find not one single instance of a cure of exstrophy in the female by the extraperitoneal method. I venture, therefore, to report as an addition to the literature the history of one in a female of successful extraperitoneal transplantation of the ureters into the rectum. The technic used I evolved from the reported cases of Lendon, of Australia, and Peters, of Toronto, both of whom transplanted the ureters into the rectum in male subjects. It is less difficult to transplant the ureters extraperitoneally in the male, because of the anatomical juxtaposition of the bladder and rectum; in the female the interposition of the uterus and vagina offers decided obstacles.

As late as 1890 it was the accepted teaching that no matter what operation was performed, a cure could not be obtained. It was figured that, although the defect in the abdominal wall could be corrected, it was impossible to create a sphincter muscle which would enable the bladder to hold the urine and the patient to voluntarily expel it. Then, too, no matter what the closure was, because of the congenital deformity the bladder itself was always very small at birth, and on account of the lack of muscular activity, not being obliged to hold the urine, there was always an undeveloped infantile bladder even in adults. In all of the plastic operations the mortality was exceedingly high and functional failure was usually the result even though the patient recovered from the operation. In 1851, however, an English surgeon, Mr. Simon, anticipated Maydl's ideas and endeavored to make an anastomosis between the ureters and the rectum, using a needle which he introduced into the ureter and the rectum, carrying silk ligatures which he knotted so tight that necrosis resulted and a fistula would occur between the ureter and rectum. This method was faulty, because, while some of the urine passed from the ureter to the rectum, a great deal of it passed down to the exstrophied bladder and the condition of the patient was not materially improved. Following this attempt was one by two other English surgeons who drew silk ligatures through the rectum and bladder, tightened them, permitting sloughing to take place and the establishment of vesico-rectal fistula. In these two cases, on account of a peculiar development of the peritoneum form-

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ing the pouch of Douglas, there occurred peritonitis because the peritoneum in these individuals came lower in the pelvis than ordinarily, and the needle passed through the peritoneum, infecting it. There followed other attempts to establish direct communication between the rectum and bladder, but were only partially successful; instead of eradicating the dribbling of urine, they simply modified it. In these attempts it is well to note that the operative mortality was high.



FIG. 1.—

In 1892 Maydl introduced a most radical departure from the previously tried methods; in fact, he revolutionized all surgical ideas concerning the treatment of exstrophy of the bladder. He introduced a method of transperitoneal anastomosis of the ureters with some portion of the intestinal canal, usually the sigmoid. He reported two cases in which he transplanted the trigone of the bladder with both ureters. His operations were successful, but were transperitoneal. On May 12, 1899, five years after Maydl's cases, Lendon, of Australia, blazed a brand new trail

and in the *British Medical Journal* of 1906 reported two cases in which he transplanted the ureters into the rectum extraperitoneally, one of which was partly successful. Simultaneously with Lendon, Peters, of Toronto, reported a case in a boy with good results, using practically the same technic as Lendon had used. Both Peters and Lendon worked independently of each other, one in Toronto, the other in Adelaide, Australia. Each is entitled to whatever credit there is in the evolution of the extraperitoneal transplantation of the ureters into the rectum in male subjects.

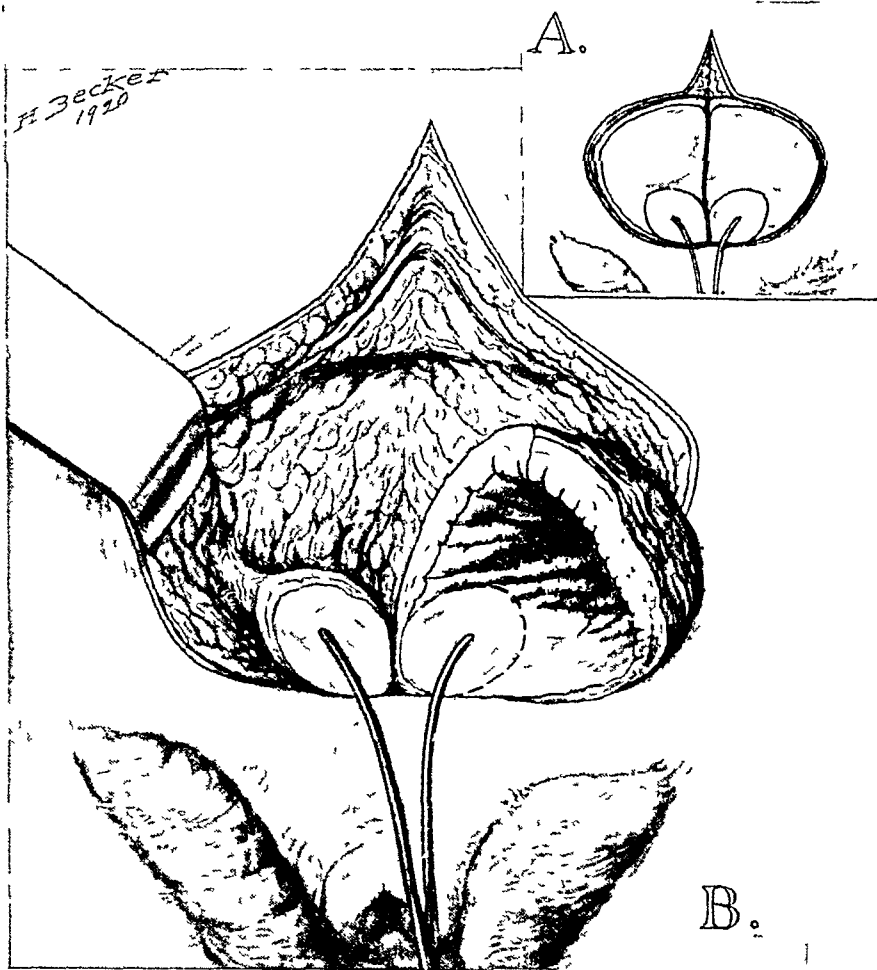


FIG 2 —

Case Report.—Female, aged sixteen years, presents a classical congenital exstrophy of the bladder. Examination reveals the following conditions: (1) A defect in the lower abdominal wall, median line, about the size of silver dollar. (2) Absence of roof of urethra in whole extent. (3) Absence of symphysis pubis—separation about 2 inches (Fig. 6). (4) Bladder protrudes during straining or coughing. (5) There are no herniæ present, though hernia is said to frequently accompany exstrophy. There are no other congenital abnormalities. The bladder capacity is about two ounces; the roof of

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bladder is absent so that since birth there has been incontinence and hence constant dribbling of urine.

Pre-operative Treatment.—(1) Castor oil $1\frac{1}{2}$ ozs. two days before operation. (2) Steam bath day before operation. S. S. enema at 4

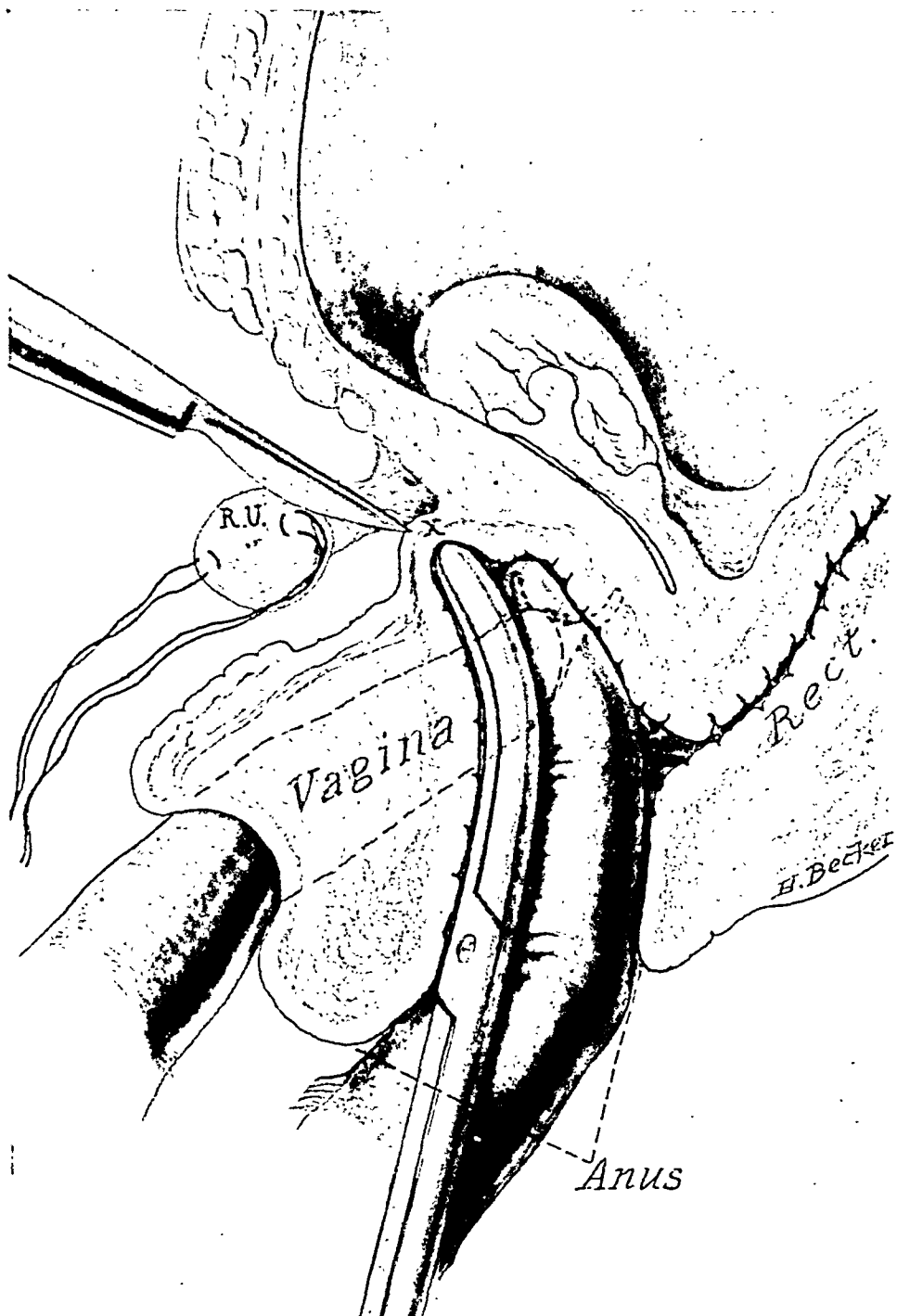


FIG. 3.—

A.M. and 6 A.M. day of operation. (3) Abdomen prepared as for laparotomy. (4) Morphine sulphate, gr. $\frac{1}{4}$, atropin sulphate, gr. $\frac{1}{150}$, hypo one-half hour before operation. (5) Ether anæsthesia. (6) Abdomen and bladder thoroughly iodized with 5 per cent. tincture of iodine. Date of operation, June 14, 1920.

Operation.—Introduction of catheters into the ureters for about 6 inches. This served a twofold purpose, (a) as guides, giving us definite knowledge of the positions and courses of the ureters; (b) as conductors of the urine from the ureters, rendering the opera-

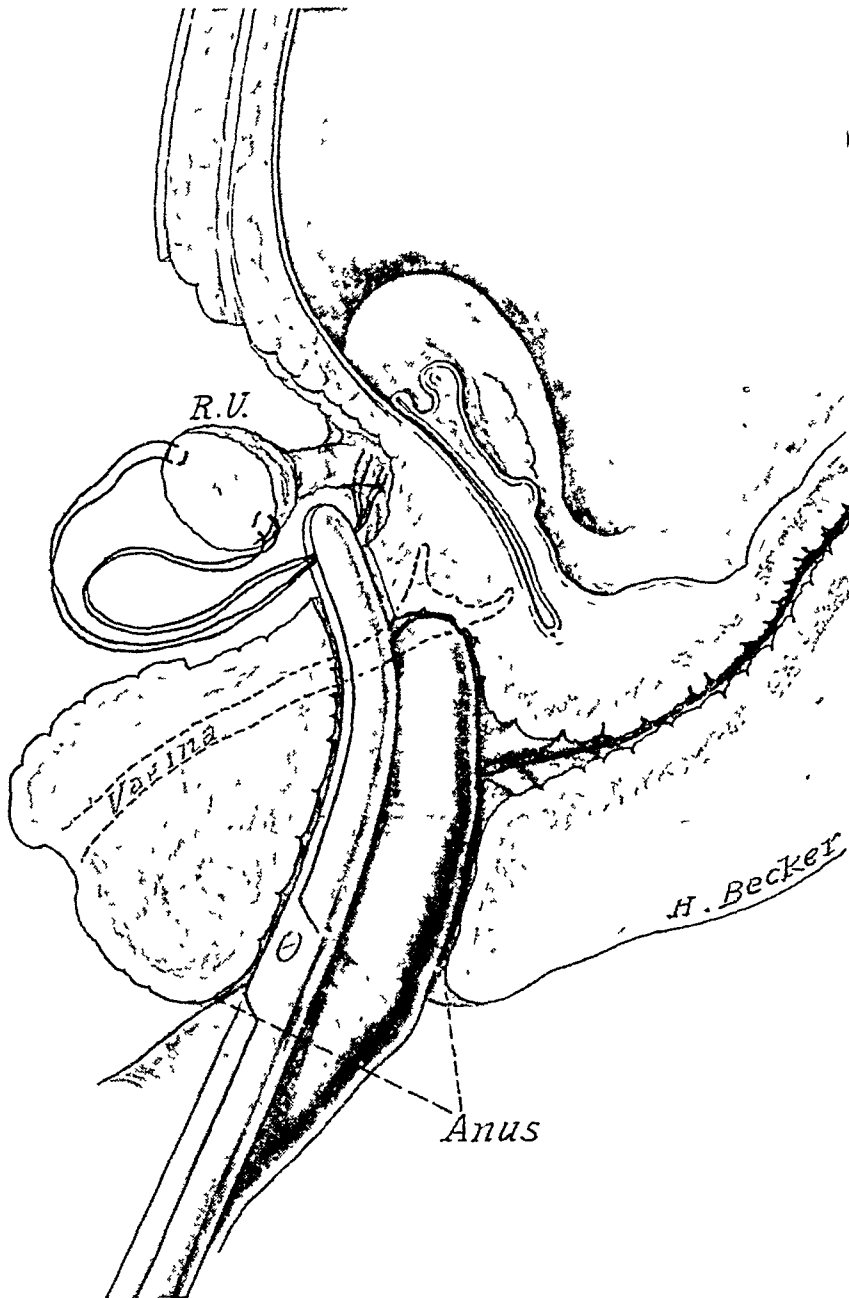


FIG. 4.—

tion field free of contamination. Beginning at the muco-cutaneous border of the bladder I made a $2\frac{1}{2}$ -inch incision through the skin and fat, in the median line, down to the rectus fascia. The fascia was split the whole length of this incision. We here encountered preperitoneal fat and very little muscle in the lower portion of the

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incision. Beginning at the posterior wall of the bladder at the lower end of the incision, with gauze on the index finger, separation of the peritoneum from the bladder was attempted (Fig. 1).

This procedure was surprisingly easy. As this gauze dissection progressed I severed with curved scissors the attachment of the bladder with the abdominal wall at the muco-cutaneous junction around the whole circumference of the bladder. The gauze dissection was continued down to the ureters, which were easily distinguished on account of the catheters previously inserted. After freeing the bladder and isolating the ureters for about $1\frac{1}{2}$ inches I split the bladder in the middle line down through the trigone (Fig. 2).

Beginning at this point I incised circularly the bladder about

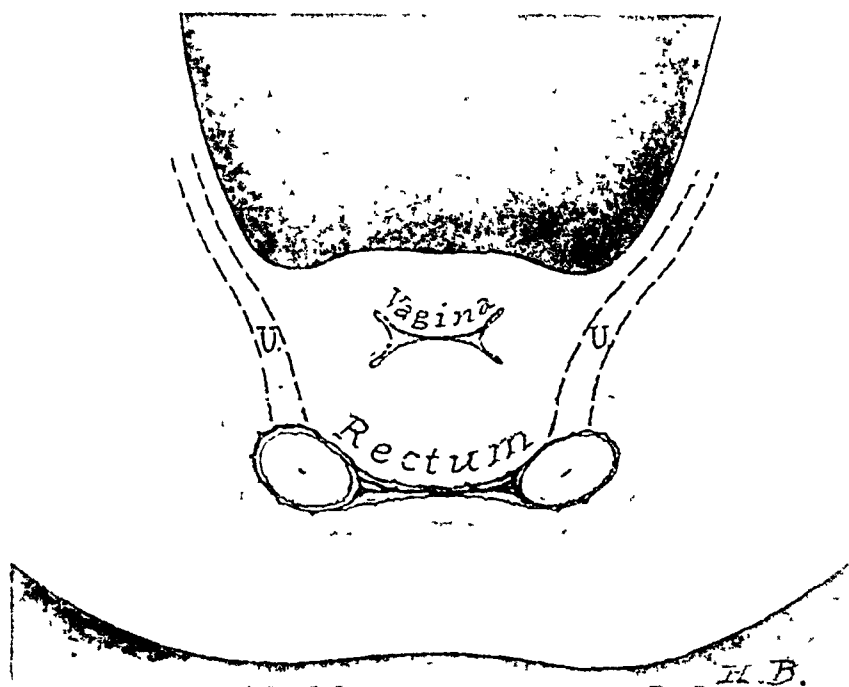


FIG. 5.—

$\frac{1}{4}$ inch away from ureter meatus, therefore, making a button or rosette of bladder with the meatus in the centre. In this manner I preserved the blood supply as well as the sphincter action of the ureter outlet. Then I inserted two mattress sutures of catgut into each rosette, leaving ends long. As an accurate guide and to facilitate this dissection, a finger in the bladder assisted materially. At this stage of the operation it was necessary for assistant to dilate the anal sphincter and introduce the index finger into the vagina and the middle finger into the rectum. Realizing that the index finger marked the limits of the vagina, we were sure that when we made our openings in the rectum we were not injuring the vaginal wall. It was not difficult, therefore, to know just where to attack the rectum. A long forceps was passed up into the rectum, the middle finger of assistant acting as a guide and pushed up to meet the operator's fingers from above. Between the operator's finger

and the assistant's middle finger were rectal wall and pelvic fascia (Fig. 3).

A small incision was made over the tip of the forceps and the latter pushed up through the rectum to grasp the long ends of catgut attached to the bladder rosette containing the ureter opening. The catgut with the ureter was then drawn through the opening made in the rectum and at completion of operation the ureters hung suspended for about $\frac{3}{4}$ inch in the rectum, about 1 inch above anal sphincter (Fig. 4).

In transplanting these lower ends of the ureters it was attempted to prevent any kinking; that is, to leave the ureters to follow practically an even course, instead of upward towards the bladder, just reversed downward (Fig. 5).



FIG 6.—

Both ureters were treated in the same manner. The remaining part of the bladder was extirpated. Iodoform gauze was packed loosely down to the rectum on either side of vagina, to act, first, to stop the oozing which was considerable, and, second, to help prevent the ureters from slipping from the rectum. The abdominal wound was closed in the usual manner down almost to the pubes; just enough opening left to permit the two gauze strips for drainage and hemostasis. The catgut strands hanging in the rectum, attached to the rosettes, were brought outside the anus and kept taut by adhesive plaster, this to prevent slipping back of ureters from rectum. A piece of rubber tubing was finally introduced into rectum, dressings applied and the operation completed.

The post-operative treatment consisted of water copiously, urotropin, gr. v, every four hours and morphine when needed for pain

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and restlessness. The day following operation the dressings were saturated with blood, but there was no leakage of urine on them. The urine passed by rectum almost immediately after the patient was returned to bed. On the fourth day the iodoform gauze drain and the rectal tube were removed.

The temperature and pulse remained up (102° F.; 120 pulse) until about the ninth day after operation, when they became normal and so remained.

During the first two weeks the patient used the bedpan every hour, with fair sphincter control. After this time patient was out of bed and the demands became less and less until now she can go the whole day without bowel movement and sleep the night through.

Clinically there are no signs of pyelitis, no distress whatever. The patient is now at work in another city. She is happy and able to go about amongst people without any embarrassment whatever.

GELATINIFORM CARCINOMA OF THE BREAST

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ACCORDING to Rodman, mucoid degeneration in carcinoma of the breast is of very rare occurrence. Of the various terms used to designate this change, that of gelatiniform carcinoma used by Billroth is probably the most satisfactory. These changes are associated with abnormalities of (1) epithelium, (2) connective tissue.

Carcinomata of the breast with abundant connective tissue framework (*i.e.*, scirrhous type) at times present great quantities of mucinous intercellular substances. The gross sectional appearance of these tumors is



FIG. 1.—Cross section of gelatiniform carcinoma of the connective tissue variety.

much the same as that of ordinary scirrhous carcinoma, excepting that the fibrous tissue has been transformed into a gelatinous mass. This lends a peculiar translucency to the specimen which is seen in only one other condition—those adenomata with an abundant and œdematous stroma, the so-called “periductal myxo-sarcoma.” These can readily be differentiated from each other; (1) in the type of gelatiniform carcinoma under consideration the gland is usually atrophic with an infiltrating carcinoma, whereas the “periductal myxo-sarcoma” is the largest of mammary tumors and is a circumscribed growth with a delimiting capsule usually present; (2) upon section (Fig. 1) this type of gelatiniform carcinoma presents delicate cords of epithelial cells infiltrating the degenerated stroma, wherein the “periductal myxo-sarcoma” presents distinct lobulations traversed by cleft-like cavities.

GELATINIFORM CARCINOMA OF THE BREAST

Under the microscope this type of carcinoma presents an epithelial growth and infiltration after the manner of scirrhus cancer. The extension appears to follow the tissue spaces. The stroma of the tumor stains poorly, is composed of connective tissue with relatively few nuclei, and rich in intercellular substances. The collagen fibrils are swollen and separated by fluid so that the cells present a water-soaked appearance. While the blood supply is usually described as being poor, the specimen seen in Fig. 2 shows a rather large number of mildly dilated vessels. It is possible that the resulting stasis indicates a disturbance that is responsible for the degenerative changes in this instance.

In carcinomas of the breast of the more cellular variety, that is, medullary type, the epithelium produces a mucoid secretion. The gross

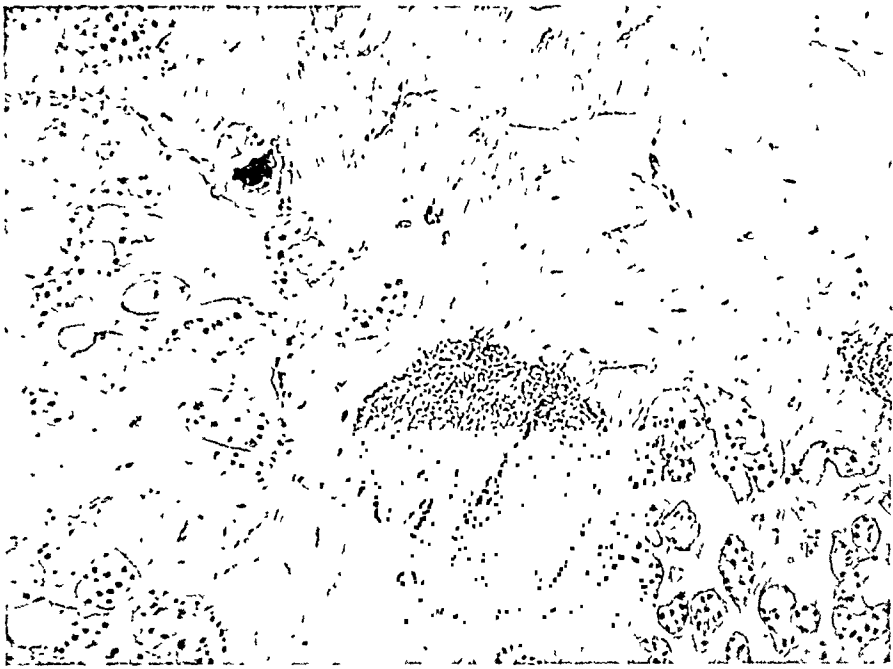


FIG. 2.—Showing mucoid change in the connective tissue with mildly dilated vessel.

sectional appearance of these tumors presents cavities filled with a gelatinous substance, so that if a thin section is held to the light it resembles somewhat a section of simple goitre. This no doubt has been a factor in the origin of the term colloid carcinoma, which is a misnomer, since the material is colloidal only in appearance. Microscopically, much the same appearance is encountered as in the gross specimen. In the smaller cavities and acini the epithelial cells are enlarged and swollen. The lumen is filled with a homogeneous material. In the large cavities the epithelial cells are small, flattened, and appear degenerated. This degeneration is not necessarily to be interpreted as a conversion of the cell cytoplasm into the mucoid substance, but is largely due to the pressure of the secreted material upon the cell within the confined spaces of the tumor.

Since the presence of gelatinous material is the evidence of retrograde

change in these tumors, one would expect them to be of slower growth, longer duration, and relatively less malignant. While these tumors are less malignant than other growths of the same cellularity, this apparently has no practical significance in view of the fact that both of the specimens forming a basis for this description were accompanied by lymphatic involvement.

It is also interesting to note that the presence of the mucoid substances in mammary cancer gives rise to a diagnostic sign first noted by Dr. W. S. Halstead. As described by him, it is characterized by a peculiar sensation imparted to the examining fingers when manipulating the breast. It is as if something within the gland had been burst or ruptured, resulting in a sudden forcing of fluid out into the intercellular spaces. The term "swish" probably best describes it to them who have not experienced the sensation.

Summary.—Gelatiniform carcinomas of the mammary gland are not of frequent occurrence. This gelatinous degeneration may occur in the epithelium or connective tissue. The elaboration of these mucoid substances is produced by an unknown cause, possibly associated with disturbances in nutrition. This change gives rise to the diagnostic sign of Halstead. This type of tumor is the less malignant of the ordinary types of carcinoma of the breast. While this fact is to be considered, it does not invalidate the other and more important factors entering into the prognosis.

The writer would here express his appreciation to Dr. Jonathan Forman for suggestions and photographs.

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TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held October 4, 1920

THE PRESIDENT, DR. GEORGE G. ROSS, in the Chair

IMPERFORATE ANUS

DR. JAMES H. BALDWIN presented a child, two and one-half years of age, who in August, 1920, was brought to the Methodist Hospital with the statement that it had swallowed a penny some time before, which had not yet been recovered from the stools. Upon examination the child was found to have an imperforate anus with the rectum opening into the vagina through which the feces were being regularly discharged. In a pouch of the rectum beyond this fistulous opening the coin was found. It was removed through the vaginal fistula. An operation for the formation of a normal anus was contemplated at a future time.

DR. A. P. C. ASHHURST remarked that Rizzoli, an Italian, many years ago (1856) devised an operation for this form of imperforate anus. He claimed that the sphincter of the anus is not at the opening in the anal region, but at the opening in the vagina. Therefore, he dissected the opening in the rectum free from that location, bringing the vaginal opening of the rectum down to the proctodæum.

DR. JOHN H. JOPSON had had the opportunity of seeing and operating on a number of cases of imperforate anus in his service at the Children's Hospital and elsewhere. The cases of rectovaginal fistula constitute the commonest variety. In these cases he had been accustomed to operate when they were first seen, and usually within the first few months of life. The operation is easy as the rectal pouch is near the surface of the perineum, and can readily be brought down and sutured to the skin. There is always a tendency to contraction of the new anus which requires subsequent dilatation to maintain its patency. He had not had the opportunity of following the hospital cases in later life, and of closing the vaginal fistula.

CHONDRO-SARCOMA OF PLANTAR SURFACE OF FOOT

DR. JAMES H. BALDWIN reported the case of a man, aged forty-five years, who had had a growth on plantar surface of right foot for twenty years. Up to two years ago it was about the size of his thumb. Since then it increased until it was the size shown in the photograph (Fig. 1), and he was compelled to walk on the side of his foot. The tumor was subcutaneous, had a capsule of its own, and was easily shelled out. When

removed the flexor tendons were exposed. The wound healed without complications. The excision was done September 2, 1920. The pathological examination made by Doctor Russell Richardson shows this to be a mixed tumor, a chondro-sarcoma, a form of tumor, while not uncommon, he had not seen or heard of in this location. They probably arise



FIG. 1.—Chondro-sarcoma of foot.

from embryonal cells capable of producing more than one type of adult tissue and may descend from one or all layers of the embryo. They usually represent two, or at most three, types of cells.

POST-OPERATIVE ENDOCRINE DEATH

DR. GEORGE G. ROSS reported the case of a woman who was admitted to the Methodist Hospital in April, 1920, on account of persistent vomiting. She had been ill about two weeks. The attack began with a severe chill lasting for about fifteen minutes, followed by persistent vomiting and bleeding from the vagina, lasting for two days. She did not pass any clots or shreds that indicated interrupted pregnancy. She also stated that at the very beginning of her attack she was jaundiced. Her bowels had been moving regularly. At the time of admission she complained of slight

POST-OPERATIVE ENDOCRINE DEATH

epigastric pain. She had suffered from indigestion for years. She had no symptoms referable to the cardiac, renal, nervous, or pulmonary systems.

When admitted her temperature was 97° ; pulse, 100; respiration, 26. She was a very weak, sick-looking, emaciated white adult of twenty-two years. The skin was hard and very dry, mouth dry and tongue red. The conjunctivæ were pale. The patient's general appearance was one of a moderately advanced case of inanition. The thing that was the most striking was the impression she gave of being very much in need of fluids. There were no abnormalities about the head or neck. The tonsils were chronically diseased. The heart was negative except for a slight acceleration. The lungs were negative. Abdomen was soft throughout, no marked rigidity. There was a mass about the size of a lemon in the right upper quadrant under the costal margin. It moved downward with respiration, but was not movable otherwise. On account of the extreme thinness of the abdominal walls the mass could be palpated from the loin, but could not be pushed into the kidney pouch. The abdomen was otherwise negative except for slight tenderness on deep pressure over McBurney's point.

Blood.—Red blood-cells, 3,920,000; white blood-cells, 15,000. Heart-beats, 80.

Urine.—1020, acid, trace of albumen, no sugar, no casts.

The treatment for the vomiting having failed and as the woman was rapidly growing worse, it was decided to open her abdomen, as it was hoped the tenderness over McBurney's point and the leucocyte count indicated a low-grade inflammation of the vermiform appendix, and its removal would control her only symptom, vomiting, and that the incision in the abdomen would afford an opportunity to establish the character of the tumor. Operation by Doctor Ross. Right rectus incision. Gall-bladder normal. Stomach normal, pylorus patulous, duodenum normal. The mass felt upon abdominal palpation was found to be the right kidney displaced downward and forward. It could not be replaced in the kidney pouch. The left kidney was movable. There were adhesions about the cæcum, the appendix was thickened and sharply angulated in the middle. The appendix was removed in the usual manner. The pelvis was inspected and found negative. The peritoneum had no fluid in it and the rectus muscle had the appearance of dried beef. The abdomen was closed without drainage.

The patient reacted well from the immediate effects of the operation. She was given 1000 c.c. of salt solution by bowel before leaving the operating room, and after returning to the ward was given continuous proctoclysis. She recovered from the ether with no vomiting and as soon as she asked for water it was given her. She did not vomit this. The first twenty-four hours after operation were uneventful and the patient retained all the fluid that was given her both by mouth and by bowel. At the end of this time her pulse and temperature rose rapidly from 100 and

99°, respectively, to 170 and 106°. She had passed both gas and fæces since the operation and had voided 50 ounces of urine. In spite of ice packs the temperature and pulse continued to rise and the patient died in a convulsion about thirty-six hours after operation.

Doctor Ross reported also the case of a woman who was operated upon in 1918 for repair of the cervix and intra-abdominal shortening of the round ligaments. Patient had had an attack of abdominal pain two weeks before her admission to the hospital. On the fourth day of this attack she had a severe uterine hemorrhage confining her to bed. There was a temperature of 101°. She vomited foul-smelling, brownish material. On the fifth day she experienced relief from the pain upon the passage of flatus and fæces as a result of an enema. The vomiting stopped immediately. A day before admission she had a recurrence of her symptoms. A diagnosis of incomplete intestinal obstruction was made, and for the second time her symptoms were temporarily relieved by an enema. An appendectomy had been performed twenty-two years ago.

Previous medical history, family history, and social history negative. Physical examination negative—except for a general tenderness of the lower abdomen, especially marked on the left side. Vaginal examination demonstrated a slight bloody discharge. The cervix was enlarged, soft, and the os dilated. The uterus was enlarged and tilted to the left and was fixed in this position. There was a left-sided pelvic mass the size of the fist which was tender to palpation.

Ten days after admission she was operated upon for a fibroid uterus and a sub-total hysterectomy was performed. This was attended by considerable difficulty, owing to the fact that the bladder was adherent to the fibroid uterus in front and sigmoid behind. The left ovary and tube were badly diseased and were adherent in the pelvis behind the broad ligament. It was necessary to dig the ovary out of its adherent bed. There was little or no hemorrhage. The wound was closed without drainage. The operation took one hour and a half. At the termination of the operation her pulse was 135; skin was dry and warm; color of mucous membranes, pink. A few hours after she was returned to her room the temperature began to mount rapidly until it reached 104 2/5°, ten hours after operation. An ice pack of two hours reduced the temperature 2 degrees. Within fifteen minutes after its discontinuance the temperature had reached 105°. Seven hours later the temperature was 107° and the pulse uncountable. Patient became unconscious and died. Patient developed slight distention. There was active peristalsis. She passed flatus and fecal matter as a result of an enema.

This death is one that is compared with that which occurs in the toxic goitre. Doctor Ross believed these two cases to be deaths due to chemical toxæmia, a result of hyperactivities of the ductless glands, probably of the adrenals.

In the second case it is possible that the traumatism caused by the

ACUTE PANCREATITIS COMPLICATING PREGNANCY

removal of the ovary may have liberated a chemical toxin which, being driven into the circulation, might account for the subsequent events.

DR. H. R. OWEN said that two or three years ago, during the month of August, he operated on a child at the Orthopædic Hospital on an excessively hot day. The temperature in the operating room must have been over 100°. The operation was tendon transplantation—an operation which should have been postponed until a cooler day. During the operation he noticed that the patient became very flushed and the skin felt very hot, and was not perspiring. The child's temperature was taken and found to be 106°. Pulse was running between 140 and 150. Both temperature and pulse had been normal previous to the operation.

He believed that this child suffered from a heat stroke. The child was very ill for about forty-eight hours, but recovered.

The moral this case taught him was never to operate on any case, excepting an emergency, on an excessively hot day.

He did not know whether Doctor Ross's two cases were in the same category as this case, but when he stated that one of his operations had been performed in August, Doctor Owen recalled this case of heat stroke, which he feared for twenty-four or forty-eight hours was going to terminate in a fatality.

DOCTOR ROSS rejoined that he was familiar, as all are, with the sun-stroke which may occur during operation, having seen it develop with the patient on the table. These two women complained of great heat while their extremities were cold; there was a peculiar expression about the face and there was semiconsciousness. The first woman died with convulsions. He had been groping for some plausible explanation of the phenomena presented and had thought of the endocrine theory only because it seemed to him to be about as reasonable as any other.

ACUTE PANCREATITIS COMPLICATING PREGNANCY

DR. W. P. KROGER (by invitation) reported the following case of acute pancreatitis complicating pregnancy on account of its extreme rarity. The patient, a married woman, twenty-four years of age, and seven months pregnant, was admitted to the Lankenau Hospital in August, 1920, to the service of Dr. George Ross. Her chief complaint was acute pain in the upper left abdomen. Her health had been very good until two weeks before admission to the hospital, when she took a long automobile ride. Following the trip she began to notice mild, generalized, abdominal discomfort. She felt tired and vaguely ill. Two days previous to entering the hospital she developed sudden pain in the upper left abdomen. This pain gradually became more severe and in twelve hours it was very acute. She then began to vomit and continued to vomit frequently and profusely. At first there was a little blood in the vomitus which she thinks may have come from her throat. Later the material became dark green or brown. No fecal odor to this material. No purgative was given and several

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enemas gave only a slight result. The pain continued to be severe, she became very weak and was sent to the hospital.

There was nothing of importance in the past medical history. Her menstrual history was negative and she had one healthy child.

Examination revealed an obese adult. Skin was cold and clammy and she was evidently in a condition of shock. The pulse was weak, running about 160. The temperature was subnormal, about 97° , and the respirations were 36. Her blood-pressure was 96 systolic and 64 diastolic. The head was normal. Face was pale and the tongue was heavily coated. The neck was negative. Aside from rapid rate, the heart was in good condition. The lungs were clear. The abdomen was distended with a pregnant uterus. There was moderate tenderness throughout the upper abdomen, especially on the left of the midline. No rigidity was noted and no masses were felt. Peristalsis was diminished. The uterus was enlarged, hard, slightly tender and freely movable. The vaginal examination was negative. The extremities were cold.

A blood count showed 80 per cent. of hæmoglobin, 5,000,000 red cells, 30,000 white cells, and 90 per cent. of polymorphonuclears. The urine contained no sugar, a slight amount of acetone and diacetic acid, and a few granular casts.

About six hours after her admission the patient complained of severe pain in the lower abdomen and she suddenly aborted a dead foetus with the membranes intact. Following the abortion she became much weaker, her temperature arose to 103° , and the pulse became very rapid. Her condition continued from bad to worse, she became cyanotic, and twenty hours after entering the hospital she died.

An autopsy was performed. Upon opening the abdomen a considerable amount of dark brown fluid was noted, the "beef broth" fluid of pancreatitis. The stomach and upper intestines were dilated. The lower ileum was markedly constricted. The omentum contained many white areas of fat necrosis. The pancreas was acutely inflamed and showed almost total destruction by necrosis. The liver, gall-bladder, and other abdominal organs were apparently normal. The microscopic sections showed acute suppurative hemorrhagic pancreatitis and fat necrosis of the omentum.

When making a diagnosis of this case a number of conditions should be considered. Chief among these are acute cholecystitis, acute pancreatitis, perforated peptic ulcer, and acute intestinal obstruction.

Doctor Gatewood, of Chicago ("Surgical Clinics of Chicago," vol. iv, No. 4, page 801, August, 1920), reports a case similar in some respects to this one, but in his case the initial symptoms occurred directly after pregnancy. He operated upon his case, draining the pancreas and the gall-bladder. His case recovered. He advises operative interference in all cases. Other than this no similar cases could be found in the literature.

Dr. George G. Ross said that this woman was sent into the hospital

GUNSHOT WOUND OF THE SHOULDER

with the diagnosis of acute perforation of the stomach or duodenum. I could not satisfy myself that such was the condition. The woman's pregnancy obscured the situation. He was unable to make a diagnosis, but was able to stay his hand, and the post-mortem proved the wisdom of not doing anything, for the whole pancreas was sloughed away.

ISOLATED FRACTURE OF THE LESSER TROCHANTER OF THE FEMUR

DR. E. B. HODGE reported the history of a woman, aged seventy-four years, who was admitted to the Presbyterian Hospital with a diagnosis of "broken hip." She had become dizzy and fallen on her left side. There was tenderness over inner upper left thigh, slight eversion and no shortening. X-ray showed a fracture of the lesser trochanter. The leg was treated by light extension with the thigh in moderate flexion. X-ray one month later showed satisfactory callus. Ashhurst, "Principles and Practice of Surgery," Second Edition, quotes Metcalf as having in 1915 collected seventeen cases of isolated fracture of the lesser trochanter.

DR. GEORGE G. ROSS said that he had seen two cases of fracture of the lesser trochanter, both in baseball players. The injury had occurred in their effort to recover their balance after having missed the ball. Both were dressed with partial flexion.

ISOLATED FRACTURE OF THE TUBEROSITY OF THE ISCHIUM

DOCTOR HODGE also reported the case of a man, aged forty-five years, who was admitted to the Presbyterian Hospital in March, 1920. He had fallen 40 feet from a tree, landing full on his buttocks upon a macadam roadway. There was considerable shock. No gross injury could be found except a tender swelling in the region of the right tuberosity of the ischium. X-ray showed fracture at this point only. Besides the rarity of the fracture, a point of interest was the high degree of paresis of bowel and bladder. Early in the case the diagnosis of rupture of the bowel had to be seriously considered. There was ultimate union and patient walked out of the hospital in seven weeks. He has, however, not yet recovered from the effects of the shock to his nervous system.

W. D. HAINES (ANNALS OF SURGERY, February, 1920), in recording an instance of isolated fracture of both tuberosities, states that search of the literature showed no record of an uncomplicated case. Ashhurst, *loc. cit.*, states that the tuberosity has been detached by muscular violence. Haines properly emphasizes the importance of rectal approach for diagnosis and reposition of fragments.

GUNSHOT WOUND OF THE SHOULDER

DR. JOHN H. JOPSON presented a woman seen at the Presbyterian Hospital. She had been shot the previous evening at close range by a 38-calibre revolver, the bullet entering on the left side at the anterior border of the deltoid muscle, near the apex of the axilla, and lodging in the

bone at the level of the base of the greater tuberosity. There was no evidence of vascular or nerve injury. The usual operation of *débridement* was done. The ball had traversed the deltoid muscle and lodged in the bone. It was removed from this bed, and found to be partially wrapped in a portion of cloth from the patient's dress. Cultures were taken from this. Owing to the length of time elapsing since the wound was received, twenty hours, it was not sutured, but packed with Dakin gauze. This was removed at the end of twenty-four hours, and the Carrelling of the wound begun. Cultures and counts were made from the wound on the second day. Laboratory reports were as follows: From the cloth wrapped about the bullet two organisms were obtained, *viz.*, a Gram-positive bacillus unidentified, and colon bacillus. From the wound two days later, a Gram-positive bacillus, non-spore bearing, identified culturally as the Hay bacillus, and present in the proportion of 1.5 organisms per field. With these reports the completion of the suture by the delayed primary method, was undertaken with complete confidence. On the third day, after anæsthesia and complete preparation of the field antiseptically, including iodine, the deep structures were approximated with chromic catgut, and the skin edges with silkworm-gut. No drainage. Three times was the patient anæsthetized. Primarily with ether; the Dakin packing was removed while under Savariaud, and the final closure was made under nitrous oxide gas. The case was a demonstration in civilian practice of the applicability of the lessons learned in many thousands of cases during the war. The result was a perfect one, and the period of disability negligible after her discharge from the hospital twelve days after injury.

MIXED TUMOR OF KIDNEY

DOCTOR JOPSON also reported the history of a little girl of three years, and exhibited the specimen removed. The child had a negative family history, and enjoyed good health until six weeks before her admission to the Presbyterian Hospital. At this time she began to be peevish and fretful. One week before admission her mother while lifting her noted the presence of a tumor in the right side of the abdomen. Examination of the urine showed the presence of red blood-cells, and the child was seen to be anæmic.

On admission to the hospital she was in fair general condition. The blood report showed red blood-cells, 3,650,000; whites, 10,085; hæmoglobin, 48 per cent. The urine report was as follows: Specific gravity, 1022; reaction, acid; sediment, slight flocculent; albumen, very faint trace; sugar absent; red blood-cells in small amount, and white cells more numerous. A large tumor was readily detected on the right side extending several inches below the costal margin, and visible, palpable and movable. No evidence of metastasis could be found. The tumor was evidently of rapid growth, as the mother was an observing woman, a



FIG. 1.—Supracondylar fracture of femur.

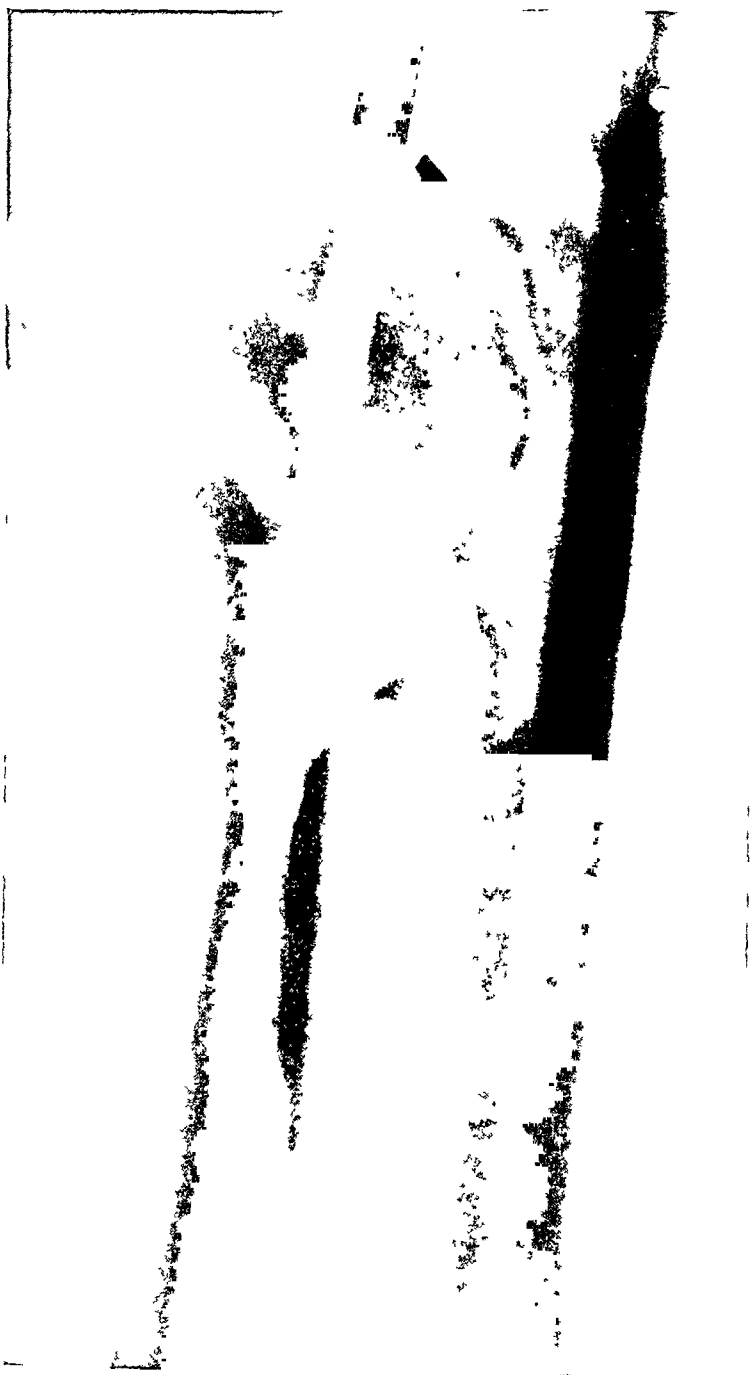


FIG. 2.—Imperfect reduction by traction tongs applied to the tuberosity.

trained nurse, and the widow of a physician, and it had only attracted her attention a week before.

Four days after admission a transperitoneal nephrectomy was done through a right rectus incision. The large tumor was adherent to the subperitoneal structures, and ruptured while being lifted and separated. Some thick gelatinous degenerated tumor content escaped. There was no bleeding to speak of, and the operation was simple of execution. There was considerable shock immediately following removal. The wound was closed without drainage. Reaction was rapid, and convalescence smooth.

Two weeks after operation the patient was subjected to radium treatment by Doctor Newcomet at the Oncologic Hospital. After which she was sent home in good condition. For about six weeks she seemed in fine health, gaining weight, of good color, playing, and in fine spirits. She then again became peevish and languid, her appetite failed, and she complained of pain in the abdomen. There was no definite demonstrable sign of local recurrence, although this was suspected. There was a short period of acute illness, with vomiting and collapse before death which occurred on September 8th, two months after operation, and a little longer time after detection of the condition.

The pathological report by Doctor Speese is as follows:

Specimen consists of a kidney which measures 16 x 8 x 7 cm. The external surface is smooth. For the most part the growth is mushy and presents a soft reddish-white mass which in places has undergone necrosis and shows much hemorrhage. On cross section a portion of the kidney cortex measuring 1 x 3 cm. in diameter is apparent. Elsewhere the kidney tissue is destroyed. Microscopic examination shows a very cellular growth composed of small cells, spindle in shape, which are closely packed together, particularly in the region of the blood-vessels, the walls of which seem to be formed of tumor cells. The stroma in this region is scant, but elsewhere is well developed. The sarcomatous elements predominate, but a few atypical gland formations are seen, which indicate that the growth belongs to the *mixed tumors*. Extensive areas of necrosis and hemorrhagic infiltration are encountered. The kidney tissue which persists is the seat of hyaline degeneration and cloudy swelling.

The fatal outcome of the case, illustrating, as it does, the exceptional malignancy of this type of tumor, corresponds with what we have observed in all the cases coming under our attention. Albanan could find but seven cases in which a child survived operation longer than three years. The classical case of Abbe, which carefully traced from childhood to adult life showed no recurrence, illustrates the very rarely obtained cure, and at the same time demonstrates that this is within the realm of possibility.

A second case was reported by Doctor Jopson, a tumor of the kidney occurring in an adult male, aged forty-eight years. The tumor had existed at least eight or nine years. It was discovered at that time by a physician during the course of an examination to determine the cause of vague symptoms in the way of discomfort in abdomen and back. The surgeon at that time informed him he had a floating kidney. The symp-

toms, which he describes as a heaviness in the right iliac region, and pain in the lumbar and sacro-iliac regions, have increased somewhat in severity, and the tumor has probably increased in size. Moreover, he has become somewhat neurasthenic concerning himself and his condition. He also describes a bloated feeling and has some diarrhœa. His general health has been good, and he has worked steadily at his trade of inspector of air brakes. He was referred to the Presbyterian Hospital by Doctor Steinmetz.

His family and previous history aside from the above are negative. His general condition is good. Weight is 145 pounds. In the right side of the abdomen is a large tumor, occupying the hypochondriac and lumbar regions, the size of a child's head. Owing to the relaxation of the abdominal wall, it is visible as well as palpable, moves with respiration, and with the patient in the left lateral decubitus falls to the left side. Bimanual examination shows extension to the loin space. It is insensitive, of smooth surface, and semi-cystic in consistency.

X-ray examination by Doctors Newcomet and Steinmetz shows the ascending colon displaced far to the left, and the stomach pushed upward. They believed they could outline the right kidney separate from the tumor. Urine report: Specific gravity, 1016; sediment, none; albumen, none; sugar, none; microscop., 2" ? and few epithelial cells; very few hyaline casts. Functional P.S.P. test, (1) Amt. 40" P.S.P. 15. (2) Amt. 60" P.S.P. 25.

Blood examination: Red cells, 4,810,000; leucocytes, 10,500; hæmoglobin, 91 per cent.

Operation, September 3, 1920: Long right rectus incision from ribs to below navel. Palpation shows opposite kidney normal, and no intraperitoneal pathology. Ascending colon displaced by tumor much to left. The thin external layer of the ascending mesocolon was split. Numerous perinephric adhesions were divided, the tumor was lifted out of the abdomen, and found to spring from the lower pole of the kidney, which was fused with it. The ureter was clamped, divided, and cauterized after ligation. Two large clamps were applied to the proximal side of the vascular pedicle, one to the distal side, the pedicle was divided, and the tumor removed. Vascular adhesions and pedicle were ligated. The posterior peritoneum was sutured. The abdominal wound was closed in layers, using chromic catgut. No drainage. After operation the patient did well for three days. He could not void, and was catheterized at regular intervals, passing large amounts of urine of normal character. On the second night, being uncomfortable, he sat up twice on the edge of the bed in an effort to void. On the evening of the 5th of September he vomited, and this persisted through the night and the following day. The patient was partially collapsed with thready pulse, cold skin, and seemed very ill. The dressings were dry. Stomach washings gave temporary relief. In the afternoon inspection of the wound showed that the



FIG. 3.—After application of tongs and traction to condyles of femur.



FIG. 4 —Showing further correction by elevation of tongs and traction after partial reduction.



FIG. 5.—The fracture after final consolidation—all apparatus removed.

deeper stitches had given away, and there was nothing but skin stitches holding. The wound was reopened, the intestine covered by omentum reduced, the peritoneum found perfectly clean and sterile. The wound was resutured under gas, and the patient pronounced himself a short time later as feeling relieved, as indeed he was. His condition at once improved, all symptoms of peritoneal irritation disappeared, and he gave no further cause for anxiety.

Report on specimen by Dr. John Eiman is as follows:

Gross: Kidney and tumor attached to the lower pole. The kidney and tumor weigh 1380 grams, and measure 21 x 11 x 8.8 cm. The tumor mass is roughly spherical, and measures 14 cm. in diameter. The lower half of the kidney is split in the median line and the tumor is wedged in the kidney tissue. The kidney is pale purple in color and fairly firm in consistency. The tumor is reddish yellow in color, elastic in consistency and feels like a huge cyst. The surface of the tumor is covered diffusely with fibrous adhesions and shows numerous large distended vessels and a network of finer vessels. On pressure over the tumor there exuded from the renal vein a few c.c. of dark red blood. The renal veins show no gross lesions.

Specimen was opened after hardening for about two weeks. On cross section it showed a solid tumor mass attached to the lower pole of the kidney. The tumor was surrounded by a definite capsule which varied in thickness from 1.5 to 2.5 cm. In that portion of the capsule which separates the kidney tissue from the tumor were seen huge irregular blood-channels which in some places measure 2 cm. in diameter. The tumor was elastic in consistency, dirty grayish yellow along the periphery, and bluish black in the centre. (The dark discoloration probably due to faulty fixation.) Roughly in the central portion of the tumor is a stellate core made up of fairly dense fibrous tissue. Microscopic Diagnosis: Hypernephroma. Grawitz type.

SUPRACONDYLOID FRACTURE OF FEMUR

DR. JOHN H. JOPSON reported a case of supracondyloid fracture of the femur complicated by fracture of the tibia and fibula on the same side, treated by tongs extension. He exhibited lantern slides showing stages of reduction of the fracture. The patient, a male aged forty-two years, injured in a railroad accident and admitted to the Presbyterian Hospital, had the lesions mentioned, and additional complication to treatment in the shape of abrasions around and above the knee, at the points where it was desired to apply the tongs extension. He was therefore somewhat in the position of a battle casualty, as the chances of infection were materially increased by applying the extension at these areas. The skiagrams showed an oblique fracture about 4 inches above the articular surface, the lower fragment rotated backward and pulled upward in the manner common to this fracture. The end of the upper fragment was in contact with the upper margin of the patella. There was an oblique fracture of the tibia, and a transverse fracture of the fibula, in fair position, in their lower thirds.

In view of the abrasions, tongs traction was first applied to the tibial tuberosity, in accordance with Blake's teaching, and twenty pounds weight applied, the knee flexed and supported in a combination of Thomas and Cabot splint to fix the fracture of the tibia and fibula. This

SUPRACONDYLOID FRACTURE OF FEMUR

treatment was ineffectual in bringing about reduction, although some separation of the fragments was obtained. Seven days after injury, the skin wounds having healed, the tongs were applied above and anterior to the axial centre of the condyles, and twenty-four pounds weight applied. A few days later another X-ray showed reduction almost complete. To assist in overcoming the backward displacement and downward pull of the gastrocnemius muscle, upward traction by a canvas cuff above the knee with a pull of eight pounds was used. Later the line of extension through the tongs was raised to lift the lower fragment into line with the shaft of the femur. Slight lateral displacement amounting to one-half inch persisted. Tongs were removed after six weeks. Knee exercise was hampered beyond that obtaining in the ordinary type of similar cases by reason of the complicating fractures of tibia and fibula. At the end of eight weeks, when apparatus was removed, there was limitation of knee movement to 25 degrees. This improved rapidly, and at time of discharge, nine and a half weeks after the injury, it was inconsiderable.

Doctor Jopson said that the suspension method of treatment of fractures, which is sometimes known on the continent as the American method, has largely displaced the operative treatment of fractures of the upper and lower extremity alike. It renders it unnecessary in a very large percentage of fractures which resisted reduction by the old methods, and which were therefore considered as suitable cases for plating, slide-grafting, or open fixation by other methods. Its advantages, now generally recognized, are (1) that it secures relaxation of the deforming muscles of the fractured member, and this relaxation, produced in part by posture, when increased by a combination with traction applied by one of several methods, permits the bone fragments to fall into their proper relation. (2) It permits of mobilization of the joints of the part from the moment of beginning treatment, and thus insures prompt recovery and preservation of function, without the atrophy of muscles, and crippling adhesions which only too frequently were the bane of the surgeon who treated fractures by the non-operative or operative methods. (3) Permitting of functional rest, it also permits change of posture and relieves pain. (4) Circular constriction of the limb is avoided, and (5) in all cases of compound fracture, infected or clean, access to the wound and ease and comfort of dressing are facilitated to a degree possible by no other means. The recognition of the advantages of continuous traction by weight extension, of skeletal traction as contrasted with the Buck's extension or strips glued to the skin, naturally followed the general adoption of the suspension method in large series of cases during the war. It appears, however, that a considerable number of surgeons have been slow to give up the practice of open operation in certain of the rarer fractures, and that they would profit by a careful study of the papers of Blake, Lyle, and their assistants and associates, and would perceive the possibility of a wider application of the principles which they have emphasized. In

this connection we would like to present the following series of slides showing the possibilities of treatment in supra-condyloid fracture of the femur.

FRACTURE OF TIBIA AND FIBULA WITH NON-UNION TREATED BY OPEN OPERATION AND TONGS EXTENSION

DR. JOHN SPEESE showed the X-ray plates of a fracture of the tibia and fibula which he thought would be of interest in conjunction with Doctor Jopson's remarks. The fracture of six weeks' duration was so firmly fixed and overlapped that open operation and mobilization of the ends was necessary. The wounds were closed, tongs extension applied to the malleoli, and the leg placed in a Thomas splint. A second X-ray taken five days later showed satisfactory reduction, the slight eversion of the lower fragments was readily corrected by changing the line of extension.

While the use of tongs extension is admirably adapted to the correction of such fractures of recent occurrence, it has a distinct advantage after open operation has been resorted to. Its use in such cases insures reduction and avoids the more prolonged and dangerous operations of fixation of the fragments by metal plates or bone grafts.

DR. GEORGE P. MULLER said that a number of cases had been treated by "tongs extension" in his wards during the past few months and they have been much pleased with the results. The method seems to be without serious inconvenience to the patient, only in one case did any trouble occur, and in this some skin necrosis resulted from improper introduction of the tongs. He believed that the method will be of particular use not only in curing deformity as seen in the case reported by Doctor Jopson, but also in difficult cases of comminuted fracture in the lower third of the leg. He thought it would be simpler and more satisfactory to use the metal plate in cases of fracture high in the shaft of the femur.

DR. GEORGE M. DORRANCE said that he had had some experience with the use of tongs in Evacuation Hospital No. 1. Most of the fractures where he used the tongs were compound. In the ordinary case he does not find it necessary to use the tongs, if the Thomas splint is correctly applied. In supracondylar fractures, he had used the tongs in three cases. It has the added advantage that one can flex and extend the leg, thus avoiding the stiff knee-joint that commonly follows the old methods of treatment.

DOCTOR McKNIGHT said that in the use of the Steinman pin he had had few infections. Riedel reports forty cases of fracture of the femur and lower leg treated in this manner, and in only four did he have delayed healing of the pin openings, one for four months and the others for fifteen weeks, and these were in alcoholics. The Groves modification of the Steinman apparatus is more efficacious when the extension is to be applied to the cancellous end of bones. This consists of a small triangular plate with three pins a quarter of an inch long. They are in-

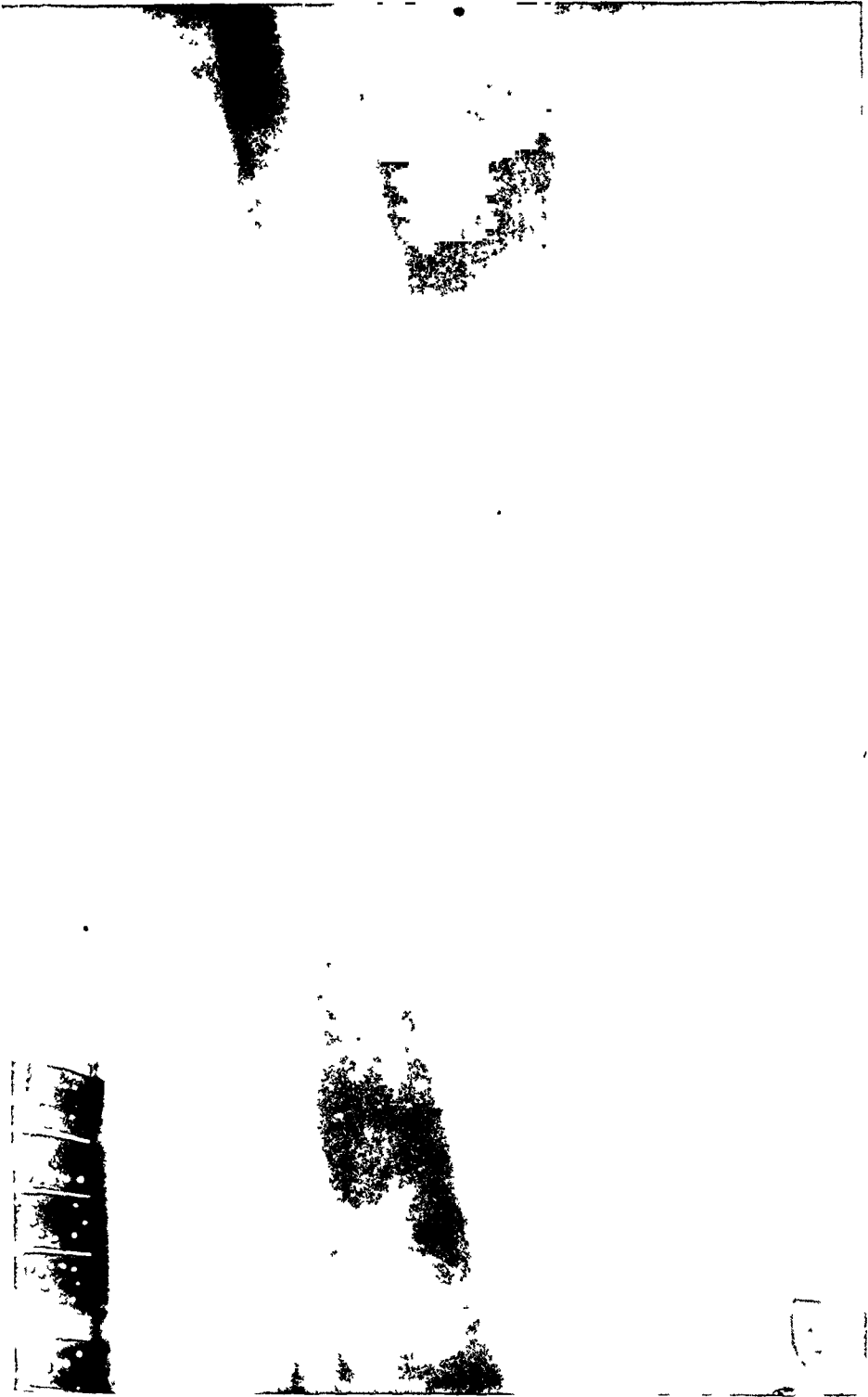


FIG 1.—Fracture of tibia and fibula before application of tongs.

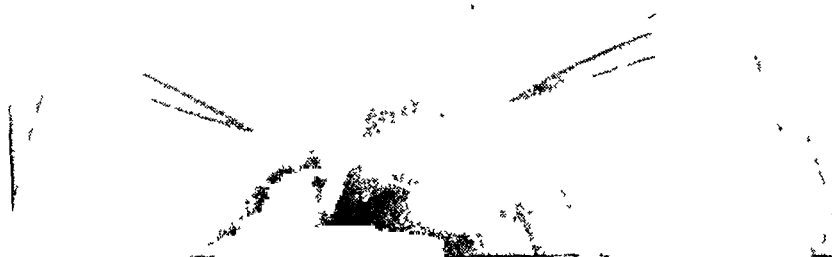
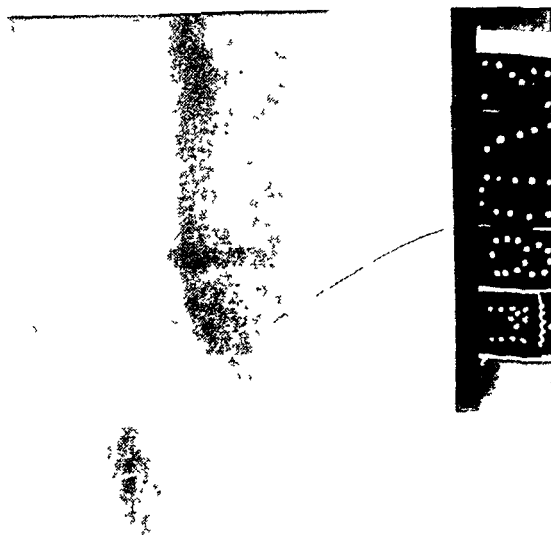


FIG 2 —Reduction by tongs extension.

CONGENITAL STENOSIS OF THE COLON

served into the condyles and are less apt to tear out or injure bony tissue than the tongs. In fracture dislocations of the ankle with anterior displacement a partial tenotomy with direct bone extension is the best treatment in this rather difficult deformity. In applying the tongs the skin should be retracted upward to prevent direct pull on the soft tissues. This method of fracture treatment is not brutal nor so painful as indirect traction of twenty or thirty pounds pull on the muscles, tendons, and ligaments as occurs in Bucks' extension.

SUSPENSION TREATMENT IN FRACTURE OF THE PELVIS

DR. JOHN H. JOPSON exhibited a slide (Fig. 1) illustrating the application of suspension apparatus as devised and used on Doctor Jopson's service by one of his former assistants, Dr. Douglas P. Murphy, for treatment of frac-



FIG. 1.—Fracture of pelvis (bilateral) with rupture of urethra and suprapubic drainage (Doctor Hodge's service). Treatment by suspension and satisfactory results from all standpoints.

tures of the pelvis. This particular patient, under Doctor Hodge's care in the Presbyterian Hospital for a fracture of the pelvis, complicated by rupture of the urethra, was a severe test of the method, and Doctor Hodge pronounced it satisfactory. Doctor Jopson had used it in several cases, including a fracture of the pelvis, with multiple lines of fracture, anterior and posterior, in a child of five years. This case, submitted to exploratory laparotomy by Doctor Speese, and later suffering from extensive sloughing of the skin and subcutaneous tissues of the back, from the fracturing force, was handled with ease by suspension in this manner, until the bones had united. All adult patients in whom it had been used voiced their satisfaction with it.

CONGENITAL STENOSIS OF THE COLON

DR. H. P. BROWN reported a case of congenital stenosis of the colon, sigmoid and upper rectum in the person of a female infant who was admitted to the service of Doctor Jopson at the Children's Hospital, June

18, 1920. She was in fair condition when born; had one black meconium evacuation after birth.

She began to vomit on the morning of the fourth day, day of admission, and continued doing so all day. The vomitus was dark green and fecal in character.

On admission the temperature was 100° ; pulse, 150; and respiration, 42.

Examination shows a fairly well-nourished child in rather poor condition. The head and chest are apparently normal. The abdomen is somewhat distended and a little firmer than usual. There is not any palpable mass present. The rectum admits the little finger up to the first joint without detecting anything abnormal.

Operation (10.30 P.M. day of admission): A 3 cm. incision was made below and to the left of the umbilicus, through the rectus muscle. On opening the abdomen free fecal material was evacuated. The small intestine was considerably distended, and of a dusky red color. A small mass was palpated in the region of the lower sigmoid, but it could not be exposed. The large bowel could not be identified. A distended loop of bowel was brought into the wound, its mesentery transfixed with a glass rod, the bowel opened and evacuated, and sutured to the wound. The abdomen was drained and closed.

The child left the table in fair condition and died three hours later.

At autopsy, the peritoneal cavity was filled with feces. The opening of the enterostomy was in the small intestine, about 24 inches from the pylorus. The small intestine was greatly distended, and showed a gangrenous perforation in the jejunum, about 1 inch in diameter, 12 inches from the pylorus. The bowel at the site of perforation had been especially distended before it ruptured. The mesenteric lymph-nodes were considerably enlarged. The cæcum was in the right iliac fossa, small and firm, and had a small appendix attached. The entire colon, including the sigmoid and rectum to within 2 cm. of the anus, was hard and firm, and cord-like in character, and approximately 0.4 cm. in diameter. The lumen would admit only a small probe, and section showed that it contained a small amount of clear jelly-like material.

Weiland,¹ quoting from Thremin several years ago, states that of 111,451 patients in the Vienna Foundling Hospital, there were only two cases of congenital occlusion of the intestine.

Lockwood,² in the St. Bartholomew's Hospital reports, states that in 16,030 surgical cases, 19 were for colotomy, which was fatal in 12 cases. Twice the great intestine could not be found. In one of these cases there was no post-mortem, and the other showed absence of the ascending colon.

Quoting from Sir Chas. Ball:³ The hind gut is all that portion behind the communication with the yolk sac, which eventually forms the entire

¹ Weiland: Med. News, New York, 1896, lxviii, p. 44.

² Lockwood, C. B.: St. Bartholomew's Hosp. Reports, vol. xix, 1883.

³ Ball, Sir Chas.: Rectum, Diseases and Developmental Defects, 1908.

large intestine and portion of the ileum. In the adult, no indication of what was formerly the mid gut normally remains, but its position is not infrequently marked by congenital malformation—Meckel's diverticulum—which is usually found in the ileum tolerably near its termination. If then the hind gut has not developed, we find the rectum and other portions of the intestine absent in whole or in part, or rudimentary, and the small intestine ending in a cul-de-sac, or having an opening at the umbilicus from persistence of the vitelline duct.

He reports a case of a child three months old with imperforate rectum and anus, extroversion of the bladder and urachus to the umbilicus, and an opening between the ureters through which fæces escaped freely, and through which the intestines prolapsed. At post-mortem the rectum, entire colon, and mesocolon and cæcum were absent. The ileum opened into the extroversion and was continued beyond the opening as a short contracted diverticulum, like a vermiform appendix, the sole remnant of the hind gut.

Dodd⁴ reports a case in which the symptoms appeared when the child was three weeks old. It died in the twelfth week, vomiting having gradually increased and the bowel movements decreased. Autopsy showed congenital contraction of the ascending and transverse colon to the size of a lead pencil. The descending colon, sigmoid, and rectum were distended but otherwise normal in appearance, with the exception of a partial annular constriction of the sigmoid.

DR. JOHN H. JOPSON said he had seen one case of congenital stenosis of the colon which resembled to some extent that described by Doctor Brown, but in which the condition of intestinal occlusion was of even greater degree. There was a congenital atresia of the entire colon, but not of the rectum. In addition, there was a stenosis of the upper portion of the jejunum at a number of points, and a great narrowing of the lower portion of the ileum. The portion of the small intestine between these points was greatly dilated. The condition of the colon was discovered as in this case when a colostomy was attempted without avail. The condition is, of course, incompatible with life. He had recently seen a case of congenital stenosis of the sigmoid, with chronic incomplete obstruction in an infant, which when seen at the age of seven months, weighed six pounds and twelve ounces. The bowels were always constipated, and after a few weeks moved only with injections, and there was frequent vomiting after feedings. A palpable mass revealed the position of the dilated and frequently impacted colon above the pelvic brim, and the X-ray examination showed an extreme degree of stenosis of the sigmoid. Only by the most skillful care and nursing had the child been carried along to this age, and operation was suggested, but as yet has not been agreed to. It now weighs eleven pounds, and is eleven months of age. The condition of the colon shows practically no change, and the dilatation is still confined to its lower end.

⁴ Dodd, A. H.: *Lancet*, 1892, I, 1299.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting held October 13, 1920

The President, DR. WILLIAM A. DOWNES, in the Chair

DUODENAL ULCER

DR. J. P. HOGUET exhibited X-ray plates of a case which he stated there were two reasons for reporting. First, on account of the operative procedure, and second, because of the old story in connection with the use of non-absorbable sutures. The patient was a man, aged forty-seven years, who first presented himself in June, 1916, suffering from the typical set of symptoms of duodenal ulcer which had persisted for a year and a half previous to this time. Dr. Lewis Gregory Cole took röntgenographic pictures at that time which showed considerable deformity of the cap and a large post-pyloric ulcer on the upper posterior surface of the duodenum. As some trouble with gastroenterostomies in similar cases had been experienced it was decided to do a modified Polya-Reichel, that was a Polya-Reichel without a pylorotomy, with the inversion of the duodenal end and taking up the jejunum with an end-to-side anastomosis with the stomach. The patient made a remarkably easy convalescence after the operation. For a year thereafter he suffered from no symptoms. Early in 1917, however, there was a recurrence of symptoms, and in examining him at this time, and giving him the test meal, the typical symptoms of duodenal ulcer were found. The radiograph showed an ulcer at the gastroduodenal stoma. The patient was put on the Lennhartz diet and at the end of about two weeks the symptoms subsided. He then went home, and though he was a rather intractable patient and did not submit readily to the regulation of his dietary, he remained well until October, 1918, when he again came back with the same symptoms of ulcer. Although at this time he did not have an X-ray taken, the symptoms were just as typical as before. The patient also recovered from this second attack on dietary treatment in ten days or two weeks and he had remained well up to the present time. The question was whether these attacks were due to two new ulcers in the duodenum due to the Pagenstecher suture. It was difficult to answer that question.

GASTRIC ULCER

DR. J. P. HOGUET presented a man aged fifty-three years, a porter, who was admitted to the French Hospital on September 13, 1920. When first examined, Doctor Hoguet said he felt fairly positive, on account of the

GUNSHOT WOUND OF THE ABDOMEN

history and the loss of weight and the low blood count that the man had carcinoma. The blood count showed hæmoglobin, 35 per cent., and red blood-cells 1,920,000. He had also with the test meal a fairly high acidity and a trace of blood. No tumor was palpable. The X-ray picture showed two craters of ulcers which practically closed off the pylorus. About three days after the patient came into the hospital he had a blood transfusion after the Unger method, 500 c.c. of blood from his son as donor being given. Forty-eight hours afterward he was operated upon under gas-oxygen and an immense inflammatory mass on the lesser curvature of the stomach was found completely blocking up the pylorus, and as large as a good-sized fist. There were several enlarged glands. Doctor Hoguet then did a posterior gastroenterostomy without the occlusion of the pylorus. The man made an easy convalescence and in ten days was taking a pretty generous diet. On October 5th the blood count showed hæmoglobin, 50 per cent., and red blood-cells 3,200,000. The gland removed was typically inflammatory. Doctor Steiner said these two ulcers had undoubtedly perforated some time previously and had formed this mass of scar tissue.

OLD UNREDUCED BACKWARD DISLOCATION OF THE ELBOW

DR. L. W. HOTCHKISS showed X-ray plates of an elbow dislocation of five months' standing when the patient came under his observation, so that closed reduction was impossible and he had to resort to open arthrotomy. The elbow-joint was opened by the Kocher incision on the radial side of the joint, and by extending the incision backward and along the triceps tendon on the radial side a good exposure was made. The head of the radius was first freed and then the ulnar side was approached. The adhesions and interposed capsule made the freeing of the joint very difficult. But a perfect reduction was finally accomplished without sacrificing the lateral ligaments and without damage to the musculospiral or ulnar nerves. The elbow was put up in flexion, about 100 degrees, and the plaster case was kept on for about two weeks to allow wound healing. About the third week baking, massage, and passive motion were begun and are being continued. The function of the joint is constantly improving and the patient is able to put the hand to the head. This was a typical backward dislocation of both bones of the forearm without fracture and, in the unreduced state of extension, the arm was quite useless.

GUNSHOT WOUND OF THE ABDOMEN

DR. A. S. VOSBURGH presented a boy aged sixteen years who was shot in the abdomen at 4.00 P.M., August 29th, as the result of three boys playing with an "unloaded pistol." The boy was brought to the United Hospital of Rye and Portchester in an automobile. The patient had vomited once since the accident; 1000 units of antitetanus serum were administered. Physical examination showed a well-nourished boy, rather small for his

age, apparently in good condition—his expression was interested rather than anxious as the result of pain. The abdomen was flat. A bullet wound was seen on the right side 3 inches to right and at same level as the umbilicus; there was slight rigidity about this area. The bullet could be felt posteriorly and below the iliac crest; its position indicated that it had travelled posteriorly and slightly downward. There was no evidence of hemorrhage, shock or peritoneal irritation other than the slight rigidity about the wound of entrance. The patient complained of numbness in the anterior surface of the right thigh and it hurt him to extend the thigh; while in bed, he kept it slightly flexed. No paralysis of any muscle or group of muscles was evident. Anæsthesia was demonstrated along course of middle cutaneous branch of anterior crural.

Operation (8.15 P.M.).—The wound of entrance was circumscribed and the abdomen entered through a transverse skin incision and an inter-muscular incision with Weir extension to gain sufficient room. A wound of the ascending colon was seen; no escape of contents was noted. The edges of the wound were inverted with purse-string suture of catgut reinforced by second, superimposed sutures. The surrounding region was explored; no other wound was found. The ascending colon was mobilized by an incision along its outer border and the posterior surface of bowel explored by rolling it toward the median line. In the loose areola retroperitoneal tissue no wound of exit could be located. The tract of bullet could be felt through the substance of the psoas-iliacus. A counter opening was made through the flank to drain this retroperitoneal region. A bullet 38 c. extracted through a third incision from the substance of the gluteus maximus; a few splinters of the ilium could be felt in this wound. Rubber dam cigarette drains were led to site of anterior perforation, to the retrocæcal region, and to the region where the bullet had lodged.

The abdominal drain was removed August 31st; retrocecal drain was removed September 2nd, while the drain to wound in buttock was not removed until September 5th. The patient was discharged September 15, 1920, when all wounds were healed except the granulating tracts at the sites of drains.

DOCTOR HOGUET spoke of two cases in which he found open wounds of the ascending colon in front and could find none behind. Both of these patients did badly and died, and he felt that there was a wound behind that he had not been able to locate. In these two cases he thought there was a retroperitoneal cellulitis. It was pretty difficult to find these wounds in the posterior surface of the ascending colon. In view of this difficulty he wondered if the proper procedure was not to drain posteriorly as well as anteriorly, as Doctor Vosburgh had done.

DOCTOR VOSBURGH seconded what Doctor Hoguet had said about looking for a posterior opening in the ascending colon. If he had to do such an operation again he would drop a probe through the anterior opening

OBSERVATIONS IN CHOLELITHIASIS

and follow up the direction of the wound to where one would expect to find a posterior opening. In this case as soon as he closed the anterior perforation he closed the peritoneum except at the site of drainage. The ascending colon was then mobilized and rolled toward the median line and one came to the areolar space where if there was much blood it was very difficult to recognize an injury, and one was unable to find a posterior hole because of the infiltration. So he thought it well to leave in a good-sized drain posteriorly. The abdominal wound was closed except at the drain, and it was closed tightly around the drain. The posterior drain emerged just above the crest of the ilium in the loin.

CHOLECYSTECTOMY FOR CHOLELITHIASIS

DOCTOR VOSBURGH presented two women in each of whom the gall-bladder had been removed for the relief of symptoms due to cholelithiasis.

OBSERVATIONS IN CHOLELITHIASIS

DOCTOR GEORGE WOOLSEY read a paper with the above title, for which see page 46.

DR. ROBERT T. MORRIS said it seemed to him the question of closure with or without drainage was one of histology rather than of pathology. If one ligated the appendix it remained ligated because it was a disappearing appendage. If one ligated the oviduct, on the other hand, it was almost always a failure because nature found a way for opening the lumen, being interested in the preservation of its function. Nature was on the fence in regard to the value of the cystic duct; sometimes it remained closed after ligation, and sometimes it opened. All three of these structures were much alike in diameter and general structure, but all three acted differently under ligature for reasons histologic and biogenetic.

As to the X-ray, we were told by the neurologists that if we wished to live long we must not worry. One need not worry about diagnosis if the X-ray showed no gall-stones; it was only necessary to tell the patient that he required an operation for cholecystitis, and then if one found stones it was all velvet. The biggest thing that ever got into the gall-bladder was the microbe, and there was no reason why we should not have recurrences such as Doctor Woolsey had shown so long as an original focus of infection was present.

The question of that class of patients in which pancreatitis was found was one of great consequence. Doctor Deaver had called attention to an acute lymphatic infection, but a chronic interstitial pancreatitis was more frequent than lymphatic infection. Sixty to 70 per cent. of all cholecystitis cases might be found to include chronic interstitial pancreatitis; that was commonly overlooked.

DR. JOHN DOUGLAS said he had some doubt as to the assumption upon which Doctor Woolsey based the conclusions that cholecystectomy was the operation of choice as the cure for chronic pancreatitis. In the first

place, Doctor Woolsey assumed the correctness of Doctor Deaver's conclusions as to the infective origin of pancreatitis through the lymphatics. Personally he could not see how an infection starting in the gall-bladder passed through the groups of lymphatic glands along the cystic and common ducts, about the pylorus and the head of the pancreas into the pancreas itself to cause a chronic inflammation, always travelling against the normal lymph stream. Such a thing did not happen elsewhere in the body. It seemed to him that the assumption of Archibald that an infection of the gall-bladder caused the change in the bile, increasing or changing its bile salt and bile acid content, and that this was responsible for the pancreatitis by reflux into the pancreatic duct rather than by lymphatic infection was a more plausible theory. He thought one would have to acknowledge a certain number of cases might be caused by the duodenal content entering the pancreatic duct, particularly when the larger of the two pancreatic ducts did not empty together with the common bile duct through the papilla of Vater. He would like to know whether in the cases of chronic pancreatitis the bile duct was drained by Doctor Woolsey and whether Doctor Woolsey considered the removal of the gall-bladder responsible for the cure of the pancreatitis. Doctor Deaver always drained and advocated prolonged drainage of the bile duct in cases of pancreatitis. Balfour has recommended the removal of the gall-bladder for the cure of chronic pancreatitis, but this was because there was a resulting dilation of the common duct and the loss of power in the sphincter of Oddi. Doctor Douglas said that this was certainly not always effectual, as he could recall one case in which he had performed a cholecystectomy for cholelithiasis and the patient died two years later as a result of an acute pancreatic necrosis.

DR. T. LE WALD called attention to the statement that "the visualization of gall-stones depends on the percentage of calcium in the stones and on the density of the enveloping bile. His own figures do not compare favorably with the larger percentages, notwithstanding that abundant material has been at his disposal. Many of the cases gave typical histories, but even in these, although extraordinary efforts were made, it was possible to find diagnostic shadows in only a small minority. The difficulty has been, not to find shadows, for these were often present, but to find shadows that are definite and characteristic." Nevertheless, Doctor Le Wald said he felt it might be well to look for stones, for in the search one might find just the information that would turn the tide of diagnosis. In fact, this had often proved to be true, though he could not say in what percentage of cases. He thought the best way to do was as they were doing at St. Luke's Hospital. Before giving the opaque meal the gall-bladder region of the patient was especially examined, and in a very small percentage of cases stones were found which were calcified. There were borderline cases in which a ring shadow might reward one's efforts and make him sure of his diagnosis. On the other hand, there

OBSERVATIONS IN CHOLELITHIASIS

were cases in which no amount of effort could ever show the type of gall-stone which was just equal in density to the surrounding bile or gall-bladder wall. Doctor Le Wald had demonstrated this by taking the freshly removed gall-bladder and placing it upon the X-ray plate and radiographing it in hundreds of instances.

DR. FRANK S. MATHEWS called attention to the fact that cases with a mild chronic cholecystitis often gave definite, intermittent attacks of pain strongly simulating biliary stone. He made the diagnosis of chronic cholecystitis on adhesions, change in color of the gall-bladder, moderate contraction of the gall-bladder, and viscid black bile. The latter was by no means constant and would seem to indicate that the attacks of pain were not necessarily related to inability of the gall-bladder to empty itself. The microscope in these cases might show but very moderate departures from the normal. If such gall-bladders—definitely the seat of chronic cholecystitis—could give attacks of pain without stones, it would suggest the advisability of removing the gall-bladder containing stones, even when the inflammation was not great.

As regards the use of the X-ray, he thought its greatest value was in eliminating other conditions of the gastro-intestinal tract. Certainly marked degrees of thickening and adhesions could exist without X-ray evidence. In four cases in which he had operated recently, diagnosed positively by röntgenologists as gall-stones, only one proved to have them.

DR. SETH M. MILLIKEN said mention had been made in the paper of the closing of the wound without drainage. It did not work. Doctor Morris says nature is on the side of the oviduct; she is on the side of the cystic duct, too. He confessed to one case in which everything seemed so dry that the wound was closed without drainage. Slight temperature and swelling in the wound on the sixth day indicated a small opening from which bile escaped for eight days. Recovery was otherwise uneventful.

DR. HERMANN FISCHER called attention to a group of cases in which there existed a chronic cholecystitis without the formation of stone. In these cases adhesions between gall-bladder and the neighboring organs of varying density were present. The wall of the gall-bladder was usually thickened, although one also might meet a gall-bladder that looked macroscopically almost normal. These gall-bladders must be removed in order to get the patients well; the removal of the adhesions would not be sufficient to effect a cure. All these gall-bladders which had been removed by him for this condition were carefully examined and all proved to be the seat of a chronic inflammatory condition.

The necessity of drainage was very much impressed upon his mind by two cases of cystic stump leakage in which no drainage was employed by the surgeon who had operated upon them. Both patients subsequently had to be reoperated upon but succumbed to the peritonitis

caused by the escaping bile. The question of primary closure after cholecystectomy had been discussed quite freely of late and he was aware that some surgeons advocated it. He himself, however, advised strongly against it.

X-ray pictures in some cases might confirm the diagnosis of biliary calculi, although even with positive findings, one might be misled. Doctor Fischer cited a case of obstruction of the common duct in which he suspected malignancy. The X-ray showed a shadow that was interpreted as being a stone in the common duct. Operation revealed a carcinoma of the common duct, with a calcified lymph-node at the angle of common duct and duodenum.

DOCTOR WOOLSEY, in closing the discussion, said that perhaps he had inadvertently given his view of Doctor Deaver's opinion rather hastily. When he spoke about pancreatitis he did not mean lymphatic pancreatitis but indurated interstitial pancreatitis. About 33 per cent. of the cases reported had that variety of pancreatitis. A certain number of these cases caused pressure on the common duct and this produced jaundice. Whether Doctor Deaver's view of infection through the lymphatics was correct he did not know. This chronic interstitial pancreatitis was quite different from acute pancreatitis. He had removed the gall-bladder in all cases of pancreatitis, but he had not drained the common duct in all these cases. If there was jaundice he drained the common duct. He agreed with Doctor Fischer and Doctor Mathews with regard to cholecystitis and the advisability of removing the gall-bladder in that condition, but he had not stressed that as his paper was on cholelithiasis and not on cholecystitis.

LARGE OVARIAN CYST IN INFANT OF SEVEN MONTHS

DR. WILLIAM A. DOWNES presented a specimen, which was removed from an infant, aged seven months. The child was admitted to the Babies' Hospital, September 24, 1920. The infant was full term; weighed 9½ pounds; delivery was normal. A smooth, symmetrical swelling was noticed in the lower part of the abdomen immediately after delivery, gradually increasing up to the present time. The condition was thought at first to be Hirschsprung's disease. The child's general health had continued good. It ate and slept normally. The bowels were regular. Examination at this time showed a well-developed and well-nourished infant with an enormously distended abdomen, showing the usual signs of encysted fluid. The length of the baby was 25 inches and the circumference of the abdomen 24 inches. Weight, 17 lbs. 2 oz. The ante-operative diagnosis was possible ovarian cyst. At operation on September 24, 1920, a lower right rectus incision disclosed a single ovarian cyst containing 2½ litres of fluid. The pedicle was tied off with No. 1 plain catgut. The abdomen was closed in the usual way. The child was discharged from the hospital October 7, 1920. Bland Sutton reported sixty

DIVERTICULA OF JEJUNUM

cases of tumor of the ovary in children under fifteen years of age. In this group the youngest case occurred in a child one year and eight months old. The earliest time a swelling was noticed in any case of this series was four weeks after birth. In the case herewith reported the swelling was noticed at the time of birth.

DIVERTICULA OF THE JEJUNUM

DR. CLARENCE A. McWILLIAMS presented a specimen obtained from an elderly gentleman aged seventy-one years, who in January, 1917, was

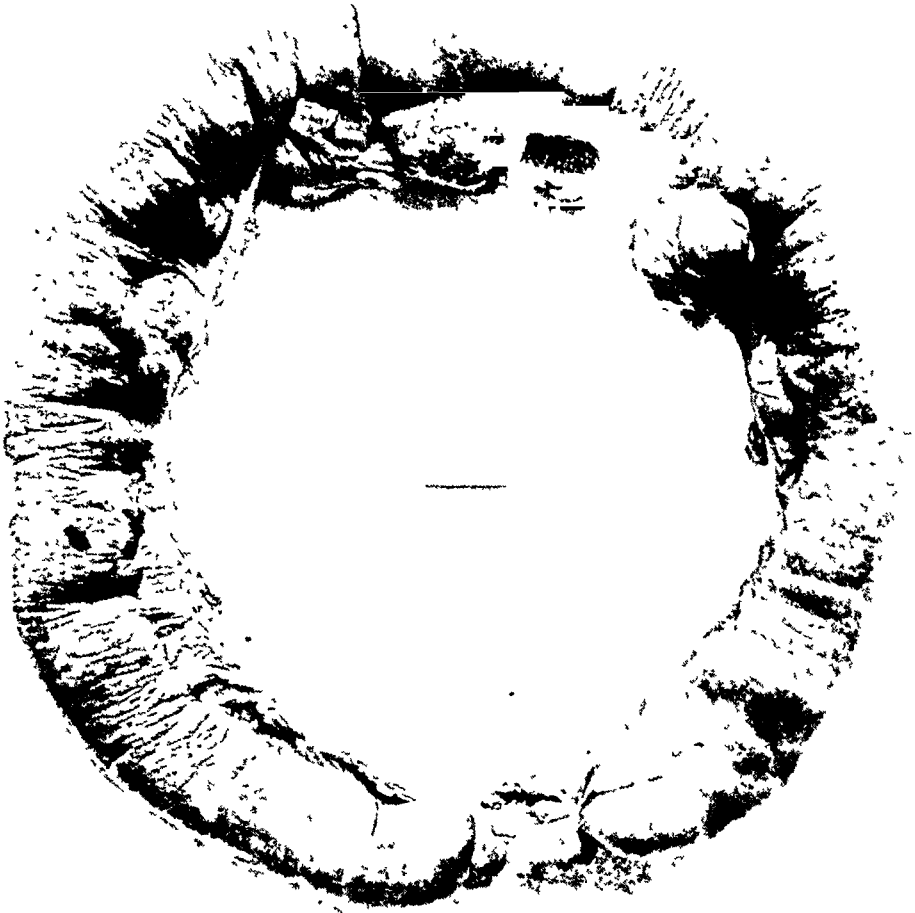


FIG. 1.—Diverticula limited to the upper three feet of jejunum.

a private patient in Presbyterian Hospital, suffering from hypertension and general arteriosclerosis. He again came into the Presbyterian Hospital as a private patient on September 8, 1920, with very acute abdominal symptoms which began twenty-four hours previously; there was exquisite pain uncontrolled by large doses of morphine, and vomiting at the onset and during the next day, accompanied by two loose, blood-free stools in the beginning, but none since. There were marked distention and tenderness of the mid-abdomen with flattening in the flanks, but without ascites or any palpable mass. Rectal examination was negative. The pulse was small, thready, very rapid and irregular. The tempera-

ture was normal. A diagnosis was made of intestinal obstruction, probably dependent upon mesenteric thrombosis. This etiology was preferred because of the hyperacuteness of the onset with vomiting, diarrhoea, colossal pain associated with mid-abdominal distention and tenderness, and a history of cardiac difficulty. Immediate operation was impossible because of the wretched pulse. Intravenous digifolin was given twice, also a high turpentine enema. No response was obtained from either. The man died within five hours without operation.

At the autopsy (Doctor Von Glahn) the small intestine was found distended and for the most part dark red in color with here and there a greenish discoloration to some of the loops. The jejunum showed the maximum amount of distention and discoloration. Along the mesenteric attachment of the jejunum there were seven large diverticula (Fig. 1), the largest of which measures 4 cm. in its greatest diameter. Some of these diverticula have numerous small bosses projecting from their surfaces. None of these diverticula were adherent to any surrounding structure, showing an absence of peridiverticulitis. The entire small intestine contained a large quantity of thick, bloody fluid. The mucosa had a very hemorrhagic appearance and there appears to be some hemorrhage in the submucosa. The large intestine was collapsed, which is difficult to explain in view of the complete inferior mesenteric thrombosis, and was free of diverticula. The stomach contained, besides gas, a considerable quantity of dark, stercoraceous, foul-smelling fluid.

In the transverse portion of the aorta there are numerous yellow plaques, many with ulcerated centres. In the abdominal aorta there are two aneurisms, one just above the coeliac axis and the second above the bifurcation, in each of which there are clots. In the superior mesenteric artery there was a clot which entirely occluded the vessel, beginning just above its first branch and running down into all of its main branches for a short distance. The orifice of the inferior mesenteric artery was entirely occluded by a clot in the aneurism just above the bifurcation of the aorta, and this vessel was entirely occluded by a thrombosis which extended down into it for 2 cm.

Diverticula in the upper small intestine alone without similar lesions in the large intestine, must be very rare, for there are but few reports of such occurrences, either met with at operation or on autopsy. It will be noticed that all these diverticula were at the mesenteric border, presumably resulting from a herniation along the vessels. I have seen no report of diverticulitis or peridiverticulitis of the small intestine, excepting that of Meckel's diverticulum.

BOOK REVIEWS

DIAGNOSIS AND TREATMENT OF BRAIN INJURIES WITH AND WITHOUT A FRACTURE OF THE SKULL. By WILLIAM SHARPE, M.D. J. B. Lippincott Company, Philadelphia. Octavo, cloth, pp. 757.

Brain surgery to-day is well advanced beyond the embryonic stage of development, and even though many problems are yet unsolved, the work of Harvey Cushing, and his associates, has established certain definite principles in operation to-day wherever the most modern standards of technic are employed.

While not entirely so, much of the brain work neglected to-day is owing to late diagnosis, when the victims of various lesions have passed their opportunities for maximum relief and when only temporary abatement of symptoms is attainable. However, with the immense amount of material of this nature needlessly ignored it still remains a matter of authentic record that the great strides of the last ten or fifteen years have placed the possibilities of this work in the lists of truly essential surgery.

Since many of the earlier restraints here encountered due to fear of death during operation, infection, etc., have been repudiated by experience, it remains to build up the weakest spot—diagnosis—so that the patient may derive the earliest and fullest recovery in each individual instance. Here lies the weakest link in brain surgery to-day, and through this casts a shadow over the entire domain, out of all proportion to the risks of operation.

But when patients continue to be neglected until tumors produce high-grade, choked disks or beginning atrophy, and in some cases paralyses, and acute traumatic cases are carried along until irreparable intracranial pressure damage is committed, the responsibility is to be found farther back than the patient's skull.

The volume under review is particularly valuable because it represents in its large amount of clinical material all types and all stages of brain lesions, both acute and chronic. Errors are frankly revealed, so that they may in future be understood before they occur, hence more readily avoided by the enlightened interpretation of experience.

Great stress is given the acute brain injuries, and particularly those associated with skull fractures, and demonstrating high grades of intracranial pressure which is given a place of first importance and justly so. This same principle of pressure within the skull is emphasized as basic in relation to tumors and other lesions constantly producing destructive effects on the intracranial contents.

The operation for purely decompressive effect, the subtemporal decompression, is given in great detail, with numerous illustrations and careful explanation of the purpose of each step in this procedure, together with a description of the special instruments used.

The last section of the book comprises an extensive treatise on acute and chronic injuries of the brain in the new-born and in children, particularly stressing those lesions of hemorrhage and its residual effects in this class of patients, urging earliest recognition for complete recovery and describing the possibilities of relief where some damage has already taken place.

This volume has much to offer, and stimulates much thought, and its usefulness is by no means restricted to the medical man engaged in the specialty of brain surgery.

HORACE G. DUNHAM.

SURGERY OF THE SPINE AND SPINAL CORD. By CHARLES H. FRAZIER, M.D.

With the rapid advances in surgery, both general and special, it has become constantly more evident that the monograph fills an important niche in medical literature, and nowhere is this more definitely exemplified than in the highly specialized branches of surgery pertaining to the central nerve system.

The past decade particularly has witnessed so many forward strides in brain and spinal cord surgery alone, that to much more than refer to them in any work on general surgery is wholly impossible. Furthermore, such material in a general work on surgery is more often designed to meet the needs of the undergraduate medical student than the man in actual practice, and for this very patent reason the work devoted exclusively to a specialized region always fills a real need for others working or interested along parallel lines of endeavor.

The work under consideration is not only complete, but exhaustive when including the elaborate bibliography for further reference and cites a vast amount of material within its pages both from the author's clinics and from those of others working in this field. One might truly call it an encyclopædia on the spine and its contents, taking up, as it does, the anatomy, physiology, pathology, and röntgenology in the same volume which discusses the practical treatment of the various lesions described.

A distinctive feature of this monograph well stated in the author's introduction, is the facility offered the reader by having all data referable to his subject in one volume, thereby obviating the frequent and often tiring process of many different books for reference on one point.

The large number of illustrations are so clear and well adapted to the corresponding text as to prove additional features of much value in practice.

The section on lumbar puncture is especially timely as it deals fully not only with the technic of introducing a needle into the spinal canal, but also with those measures of a therapeutic nature related to this procedure such as introduction of sera for tetanus and meningitis, also the treatment for syphilis of the cord as well as the method of spinal anæsthesia.

Acute and chronic lesions of all types known to affect the spinal column or its contained cord and membranes, are described and the most advanced methods of dealing with them are explained.

HORACE G. DUNHAM.

SURGERY. A Text-book by Various Authors, edited by GEORGE C. GASK and HAROLD W. WILSON. London, J. and A. Churchill. Philadelphia, Blakiston's Son & Co. Cloth, Octavo, pp. 1232.

This somewhat bulky volume does not attempt to present the whole of surgery but to deal with its practice rather than its theory, so that the principles of surgery, the history and statistics of surgery, surgical anatomy and surgical pathology, and much of clinical surgery and operative details, are omitted.

On the other hand, rather unusual in the surgical treatises of the present day, sections devoted to such specialties as the eye and ear are included. Especial interest attaches to this volume because it is made up wholly of contributions from the staff of a single English hospital, St. Bartholomews, of London. The editors in their preface state that the services of every member of the general surgical staff were secured in the compilation of the work while from specimens in the museum of the same hospital were made many of the drawings which illustrate the book.

It is as a hand-book or text-book, which presents in a general way the ideas and methods that govern the surgical practice of one of the most prominent and oldest of the London hospitals, that attention will be attracted to this book. Naturally the amount of space given to various departments will not satisfy the judgment nor the needs of everyone who may consult it. Nor in these days of monographs and elaborate studies, and of rapidly developing knowledge and subsequent changes of practice, will any surgeon who desires to keep himself up to the present-day possibilities of his work, feel that he can do without the many volumed systems and the many important monographs which are appearing at such short intervals.

The practitioner, however, who desires to have in one volume, a record of the views and practice that control to-day, the work of a great metropolitan hospital, will be glad to have this book.

LEWIS S. PILCHER.

A TREATISE ON ORTHOPÆDIC SURGERY. By ROYAL WHITMAN, M.D., M.R.C.S., England; F.A.C.S.; Associate Surgeon to the Hospital for Ruptured and Crippled in New York; Chairman of the Medical Advisory Board for Orthopædics in New York City. Sixth Edition, 914 pp., 767 illustrations. Philadelphia and New York: Lea and Febiger. 1919.

The arrangement of the sixth edition of Whitman's excellent text-book on orthopædic surgery is the same as in the previous editions. The headings of the first twenty-three chapters are also the same, although there are many additional sections to these chapters. The book is profusely illustrated and is evidently planned as a text-book for undergraduate students. As such it fulfils its purpose admirably, especially in relation to the fundamentals of orthopædic surgery.

There is a new chapter of fifty-four pages on military orthopædic surgery. This additional chapter is suggestive rather than exhaustive, illustrating some of the standard splints adopted by the United States Army and certain of the newer methods of treating fractures and joint lesions. There are also sections of the chapter dealing with artificial limbs, the preparation of the stump, nerve injuries, and tendon transplantations for irreparable nerve injuries and traumatic conditions. It furnishes an interesting commentary of the broadening scope of the specialty and indicates that we must soon derive the word orthopædic from *ὀρθός*, "straight" and the verb *παιδεύω*, "to educate," rather than from its roots, *παῖς* "a child," since training in the correction of deformity and the restoration of function in the lesions of the extremities and spine in adults has become quite as important a part of the education of an orthopædic surgeon as familiarity with the congenital and acquired deformities and bone lesions of childhood. We might well wish that the consideration of adult lesions had been still more full and that the operative procedures had been described and illustrated in more detail. The text-book nature of the work excuses this inadequate presentation and perhaps entirely justifies it, since the present amount of time allocated to orthopædic surgery in even our best medical schools is entirely insufficient for thorough training in the treatment of these adult conditions.

Whitman's orthopædic surgery is perhaps the best American text-book on the subject. It should be read carefully and often, not only by medical students, but by all graduates who enter the specialty. The style is clear and readable, the descriptive pathology is simple and yet sufficiently detailed to furnish basic conceptions of the nature of the morbid processes. The differential diagnosis is quite exhaustive and helpful. Although the methods of treatment outlined often include those advised by different authorities on the subjects under consideration, the author succeeds in impressing the reader with his own wide experience and the success of the many practical methods which he himself has originated. The excellent end-results which he has obtained by the practice of these methods are the criteria by which their value may be judged.

ROBERT B. OSGOOD.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

ANNALS *of* SURGERY

VOL. LXXIII

FEBRUARY, 1921

No. 2.

SQUAMOUS-CELL EPITHELIOMA OF THE SKIN*

A STUDY OF 256 CASES

BY ALBERT COMPTON BRODERS, M.D.

OF ROCHESTER, MINN.

SECTION ON SURGICAL PATHOLOGY, MAYO CLINIC

THE broad term "skin cancer" usually includes basal-cell epithelioma, or rodent ulcer, and squamous-cell epithelioma. As a matter of fact, the term skin cancer should include four types of epithelioma; that is, basal-cell, squamous-cell, melanotic and non-melanotic melano-epithelioma,⁴ varying in degree of malignancy with their capacity to cause death in the proportion approximately of 35 for the first, 65 for the second, and 95 for the last two types on the basis of 1 to 100.³ The recognition of the type of skin cancer being dealt with is of prime importance from the standpoint of prognosis. Carcinomas which originate in the sweat and sebaceous glands should not come under this term any more than carcinoma of the breast, as they originate from the germinal cells of specialized glands of dermal origin.

Polymorphism of Epithelial Cells.—No cells of the body are more prone to change their form than are epithelial cells. Not infrequently cells are seen in neoplasms, under the high power of the microscope, which bear a close resemblance to muscle-cells and fibroblasts, but since they can be traced directly to the basal layer of the skin, there can be no doubt with regard to their origin (Figs. 1, 2, 3 and 4).

Kettle, in his article "Polymorphism of the Malignant Epithelial Cell," states:

"That the malignant epithelial cell is capable of polymorphism is perfectly well recognized. The interchangeability of the acinus and the solid structure in adenocarcinoma is familiar to everyone, and the origin of a squamous-cell carcinoma from columnar epithelium has been reported on several occasions. Greater variations than these, however, are not, as a rule, considered possible. It is true Krompecher held that under certain conditions of growth and environment epithelial cells may assume a spindle form and may actually be converted into connective-tissue elements, but his views have not found general acceptance, and the doctrine of the specific nature of cell-growth is not seriously

* Thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Pathology, May, 1920.

questioned. Without going so far as to claim that the adult epithelial cell can actually become changed into a connective-tissue cell, I am convinced that some carcinomata may possess such extreme powers of polymorphic growth that their cells, losing all trace of their epithelial origin, may become indistinguishable from connective-tissue elements."

Krompecher's view seems somewhat illusory, but considering that the entire body is developed from the fertilized ovum, his theory is brought within the range of possibility. Squamous epithelium does not originate from columnar epithelium, as the columnar cell is differentiated and cannot regenerate. When a squamous-cell epithelioma develops in an organ in which columnar epithelium is found normally, the gall-bladder, for example, the regenerative cells which, under ordinary circumstances produce columnar epithelium, produce squamous epithelium instead. The same process takes place in an everted uterus when protective instead of columnar epithelium is needed.

Regeneration and Degeneration.—I believe that the habitual use of the term "cancerous degeneration" is incorrect. MacCarty believes that cancer is a regenerative process and not a degenerative process. Cancer tissue like other tissues degenerates. The enzyme activity of the cancer cells may cause their death and that of other cells. Cancer cells may also be destroyed by being deprived of nourishment by fibrous connective tissue. Whatever affects the general metabolism of the body affects the cancer. As is well known, the cells of our bodies are subject to the two great processes of nature, anabolic and katabolic. the former builds up and the latter tears down. Nourishing diet, fresh air, sunshine, and rest help to cure tuberculosis, but not cancer, which is a part of the body, and when food is prepared and distributed to the normal cells it is also distributed to the cancer cells.

The chronic destruction of epithelial tissue often is followed by cancer, for example, on ulcer of the lip. The destruction of the epithelial cells is a katabolic process and the regeneration by the cells of the germinal layer is an anabolic process. If the anabolic process predominates, the ulcer is healed over by normal epithelium; if the katabolic process predominates, the ulcer continues to grow. If cancer develops on the border of the ulcer, however, the cancer has both regenerative and destructive properties. Cancer cells are undifferentiated cells which have taken over new properties besides their regenerative abilities; that is, the power to invade and migrate, thereby infringing on the rights of other cells, and, depending on their degree of cellular activity, producing death of the entire organism. I believe that pernicious anæmia, myelogenous leukæmia, lymphatic leukæmia, and, in fact, all malignant neoplasias are regenerative-destructive processes, probably following, in the large majority of instances, excessive chronic destruction of differentiated cells, such as pernicious anæmia following the chronic excessive destruction of red blood-cells, and lymphatic leukæmia and lymphosarcoma following

the chronic excessive destruction of lymphocytes. Maud Slye, in her paper on the relation of pregnancy and reproduction to tumor growth in mice, concludes:

1. "Cancer and reproduction both being growth processes draw upon the same energy residuum and are made possible by the same food. Hence the food and energy used by one are withheld from the other.

2. "Therefore (a) if the female is constantly pregnant, energy and food are withheld from the tumor, and it grows with extreme slowness. (b) If there is a hiatus between pregnancies, or a termination of pregnancy, the energy which was running into reproduction is released and diverted into tumor which grows very rapidly. (c) If tumor growth considerably antedates impregnation, the currents of energy are already being used for tumor growth and are with difficulty diverted for pregnancy, probably never wholly so.

3. "Hence, when a female is well advanced in tumor growth before impregnation there are rarely any offspring brought to birth. When offspring are delivered they are few, small, undernourished and rarely suckled (which in mice means there is no lactation).

4. "When tumor growth is not interfered with by pregnancy, it is (a) extremely rapid in mice which are young, well nourished and vigorous; (b) less rapid in mice older or less vigorous or less nourished; (c) very slow in mice which are old, feeble, undernourished, or afflicted with a destructive complicating disease."

Miss Slye's conclusions are ample proof that cancer is a regenerative-destructive process.

Cell Differentiation and Activity.—In a recent paper on squamous-cell epithelioma of the lip,² I brought out the fact that the more an epithelioma tends to differentiate, the lower is the degree of malignancy. I believe this principle can be applied to malignant neoplasia in general. Very few melanotic or non-melanotic melano-epitheliomas show any tendency to differentiate, hence the high degree of malignancy; however, gland formations and squamous cells are sometimes found in these neoplasms.

The question has often been asked why the basal-cell epithelioma is of such a low degree of malignancy when it is made up of undifferentiated cells. It has been suggested that basal-cell epithelioma passes through a short cycle and differentiates into basal cells, while squamous-cell epitheliomas pass through a longer cycle in order to differentiate into squamous cells.⁵

It is well known that most of the cells of a basal-cell epithelioma bear a close resemblance to the normal basal or regenerative cells of the epidermis; however, sometimes there are cells in this type of neoplasm which contain round nuclei with deeply staining single nucleoli, "one-eyed cells"; sometimes the nuclei are irregular in outline and contain more than one nucleolus or none. I can see no differentiation in these cells; they bear a striking resemblance to the Grade 4 squamous-cell epithelioma or the melanotic epithelioma. Whenever these cells predominate in a basal-cell epithelioma it is best to give a guarded prognosis because they are liable very rapidly to infiltrate the surrounding tissues. There seems to be no reason why a basal-cell epithelioma with such active cells should not metastasize, and maybe they do.¹



FIG. 1.—Squamous-cell epithelioma of the skin, showing polymorphism of the cells (low power).

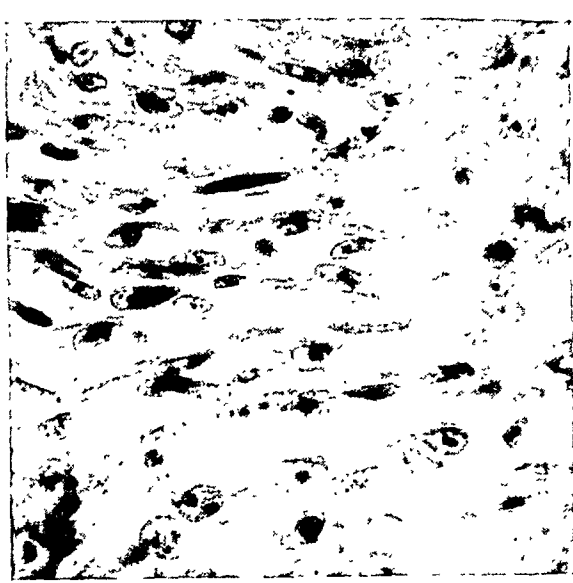


FIG. 2.—High-power magnification of section shown in Fig. 1. Note the close resemblance to fibrosarcoma.



FIG. 3 (Case A33716).—Squamous-cell epithelioma of the skin showing a marked polymorphism of the cells (low power).

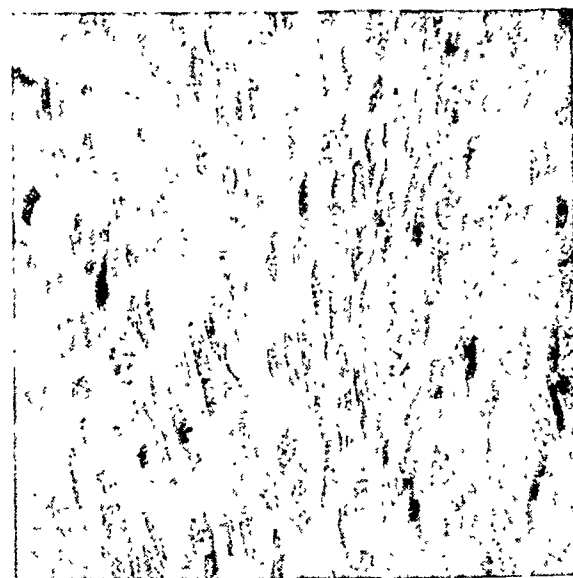


FIG. 4 (Case A33716).—High-power magnification of section shown in Fig. 3. Exact picture of myosarcoma.



FIG. 5 (Case A19884).—Grade 1, epithelioma; a, normal epithelium; b, epithelioma showing marked differentiation.



FIG. 6 (Case A60960).—Grade 1, epithelioma; a, normal epithelium; b, epithelioma showing marked differentiation.



FIG. 7 (Case A95147).—Grade 1 epithelioma; *a*, normal epithelium; *b*, epithelioma showing marked differentiation.



FIG. 8 (Case A75272).—Grade 2 epithelioma; *a*, normal epithelium; *b*, pearly body; *c*, undifferentiated epithelial cells.



FIG. 9 (Case A90006).—Grade 2 epithelioma; *a*, pearly body, *b*, undifferentiated cells.



FIG. 10 (Case A34711).—Grade 2 epithelioma; *a*, normal epithelium; *b*, epithelioma.

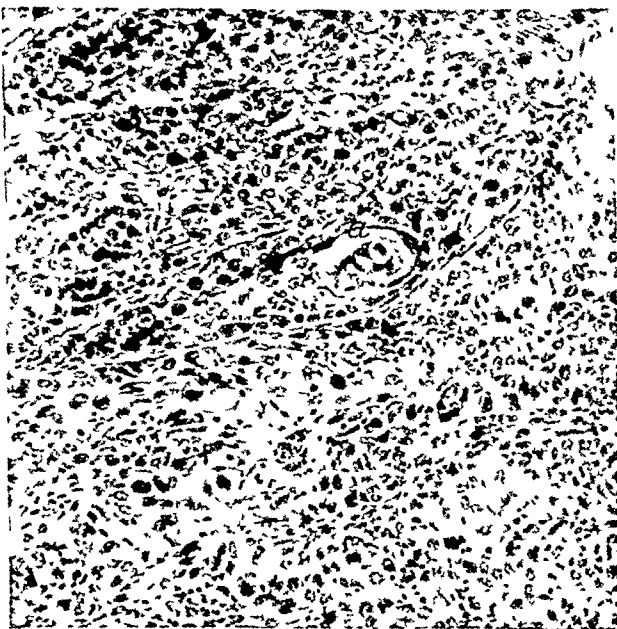


FIG. 11 (Case A53661).—Grade 3 epithelioma; *a*, epithelial cells showing practically complete differentiation.



FIG. 12 (Case A220).—Grade 3 epithelioma; *a*, practically completely differentiated cells; *b*, undifferentiated cells.

Frequently areas of pearly bodies are found in a basal-cell epithelioma; these are due to the change from basal cells to squamous cells and from squamous cells to pearly bodies.

The same general plan will be followed in discussing squamous-cell epithelioma of the skin as that in squamous-cell epithelioma of the lip.² The degree of cellular activity is graded 1 to 4 on the same basis, namely, if the epithelioma shows a marked tendency to differentiate, that is, if about three-fourths of its structure is differentiated epithelium and one-fourth undifferentiated, it is graded 1 (Figs. 5, 6 and 7); if the percentage of differentiated and undifferentiated epithelium are about equal, it is graded 2 (Figs. 8, 9 and 10); if the undifferentiated epithelium forms about three-fourths and the differentiated about one-fourth of the growth, it is graded 3 (Figs. 11, 12 and 13); if there is no tendency for the cells to differentiate it is graded 4 (Figs. 14, 15 and 16). The number of mitotic figures and the number of cells with single large deeply-staining nucleoli, one-eyed cells, play an important part in the grading. With some experience in the grading of epitheliomas, a picture for each grade becomes fixed in mind, thereby making the grading rather easy. Not all cells with single deeply-staining nucleoli are malignant; however, when they are found in a neoplasm in large numbers it is best to treat the tumor as malignant or promalignant. These cells are regenerative, and, since malignant neoplasia is a regenerative-destructive process, their presence in malignant neoplasms is not out of order.

An endothelial leucocyte is also a one-eyed cell; but it differs from the true one-eyed cell of malignant neoplasia in that it lacks body. Not all malignant cells have a single nucleolus; some have more than one and others have none. As a rule, the more malignant the neoplasm, the more irregular and ill-defined are its cell nuclei; however, exceptions to this are not infrequently seen. A pearly body in a lymph-node is not itself cancer; neither are the large flat squamous cells with small nuclei which lie adjacent to it. The pearly body is a finished product which corresponds to the horny layer of the epidermis. The large flat squamous cell with a small nucleus is almost a finished product; the keratinization of this cell forms the basis of the pearly body (Figs. 17 and 18). The large flat squamous cell with the small nucleus and the pearly body are not cancer when found in a lymph-node, as they are incapable of regeneration. Cells which are incapable of regeneration are not cancer cells. On this reasoning, the basis of grading epitheliomas is formulated.

CONCLUSIONS

1. The term "skin cancer" is indefinite and should be discarded.
2. The use of the term "cancerous degeneration" also should be discontinued.
3. The capacity of a cancer to cause death should be known when a prognosis is given.

SQUAMOUS-CELL EPITHELIOMA OF THE SKIN

4. Cancer is a regenerative-destructive process, resulting in the majority of instances from the interaction of anabolic and katabolic processes.

5. In most cases malignant neoplasia probably follows the chronic excessive destruction of differentiated cells.

6. As a rule, the more marked the differentiation in a squamous-cell epithelioma, the lower is the degree of malignancy.

7. Pearly bodies and large flat squamous cells with small nuclei are not cancer. Cancer is regenerative or undifferentiated cells.

8. The 256 cases in this series of squamous-cell epithelioma of the skin represent 12.8 per cent. of 2000 cases of general epithelioma observed in the Mayo Clinic from November 1, 1904, to July 22, 1915.

9. Squamous-cell epithelioma of the skin occurred more often in males than in females; the proportion is 4 to 1. It occurred in patients past middle life; their average age was fifty-nine and thirty-four hundredths years.

10. Squamous-cell epithelioma occurred most often in farmers; they represented 53.96 per cent. of the cases in males.

11. The site of the cancer was preceded by a mole, wart, pimple, scab, ulcer, leucoplakia, crack, wen, blister, or lump in 51.17 per cent. of the cases.

12. There was a history of injury in 23.82 per cent. of the cases; burns represented 24.59 per cent. of the injuries, and X-ray burns represented 20 per cent. of the burns.

13. The average duration of the lesion was 4.8 years and the average greatest diameter 3.85 cm.

14. Seventy-eight and four hundredths per cent. of all the lesions occurred above the clavicle.

15. Twenty-eight and twelve hundredths per cent. of the patients were treated with acid, paste or plaster, and so forth, before they entered the clinic.

16. Twenty-six and ninety-five hundredths per cent. of the patients were operated on before they entered the clinic.

17. Ninety-two and eighteen hundredths per cent. of the patients were operated on at the clinic.

18. Regional lymph-nodes or salivary glands were not removed in 77.96 per cent.

19. Of the 22.03 per cent. of the cases in which the regional lymph-nodes or salivary glands were removed, metastasis was demonstrated in 61.53 per cent.

20. The cervical lymph-nodes were involved in 31.25 per cent., sub-maxillary lymph-nodes in 28.12 per cent., the parotid lymph-nodes in 25 per cent., the parotid salivary gland in 25 per cent., and the axillary and inguinal lymph-nodes each in 15.62 per cent.

21. In a classification of the epitheliomas according to cellular activity, graded 1 to 4, Grade 1 represents 8.20 per cent.; Grade 2, 69.53 per cent.; Grade 3, 17.18 per cent., and Grade 4, 5.07 per cent.

22. The average duration of the lesion according to grade was longest

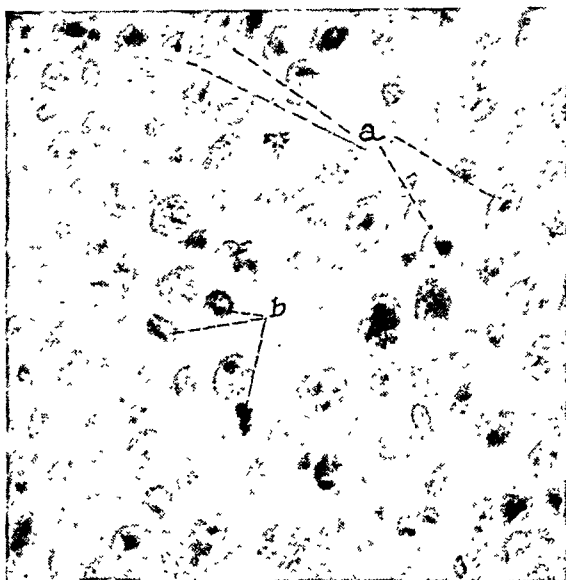


FIG. 13 (Case A38629).—Very malignant area of a Grade 3 epithelioma; *a*, "one-eyed cells"; *b*, mitotic figures. In some areas in this neoplasm the cells showed a tendency to differentiate.

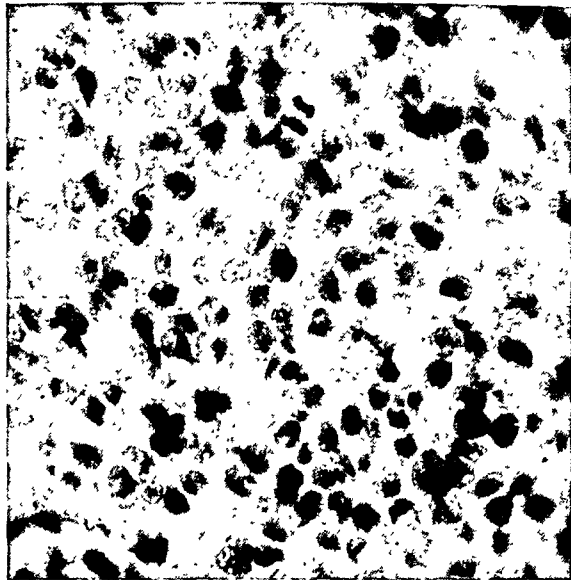
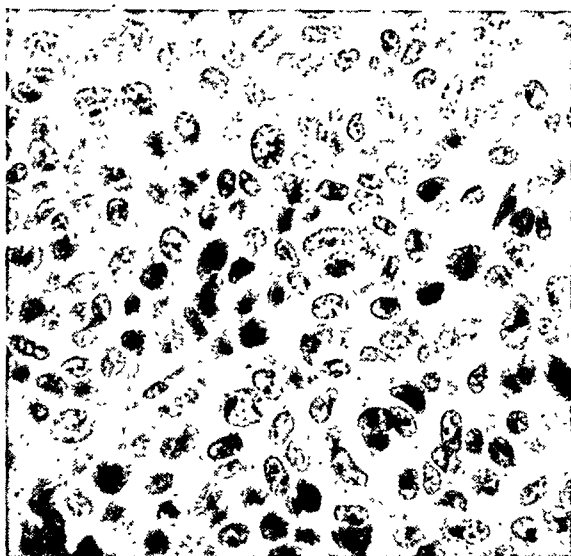
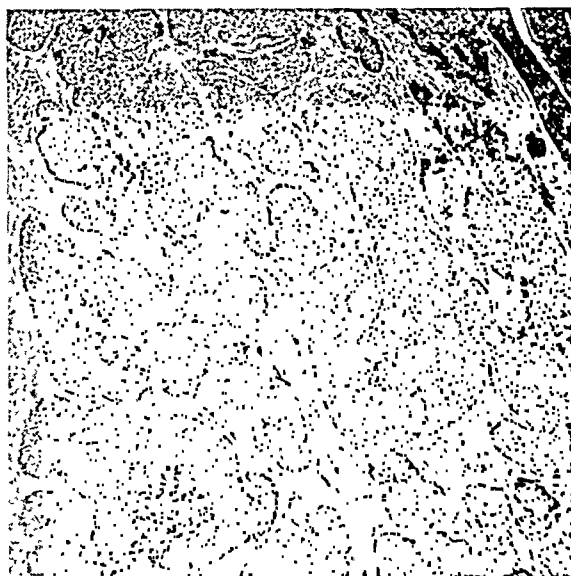


FIG. 16 (Case A118133).—High-power magnification of Grade 4 epithelioma similar to epithelioma shown in Fig. 15.



FIGS. 14 AND 15 (Case A90864).—Low-power and high-power magnification of a Grade 4 epithelioma, showing irregular pale-staining cells; very few one-eyed cells.

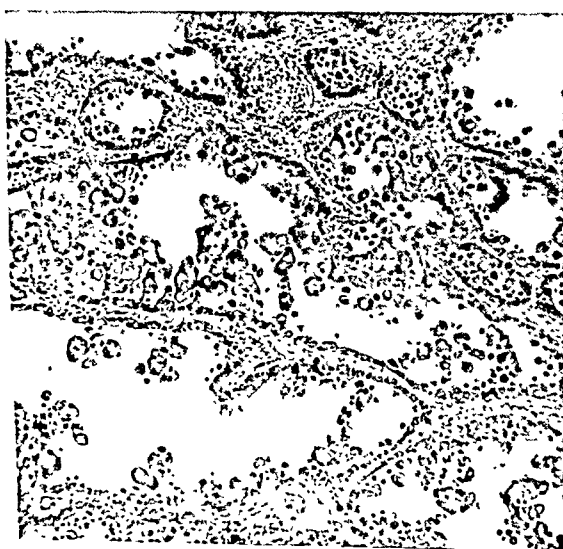


FIG. 17 (Case A56882).—Squamous-cell epithelioma of the skin, showing a number of cells undergoing keratinization (low power).

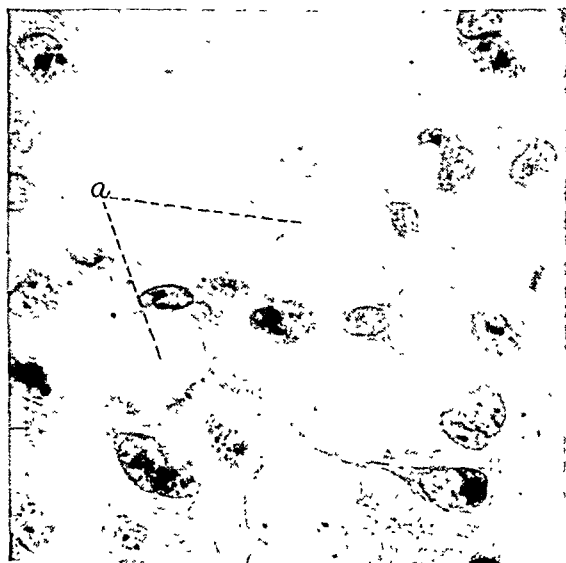


FIG. 18 (Case A56882).—High-power magnification of section shown in Fig. 17; *a*, cells becoming keratinized.

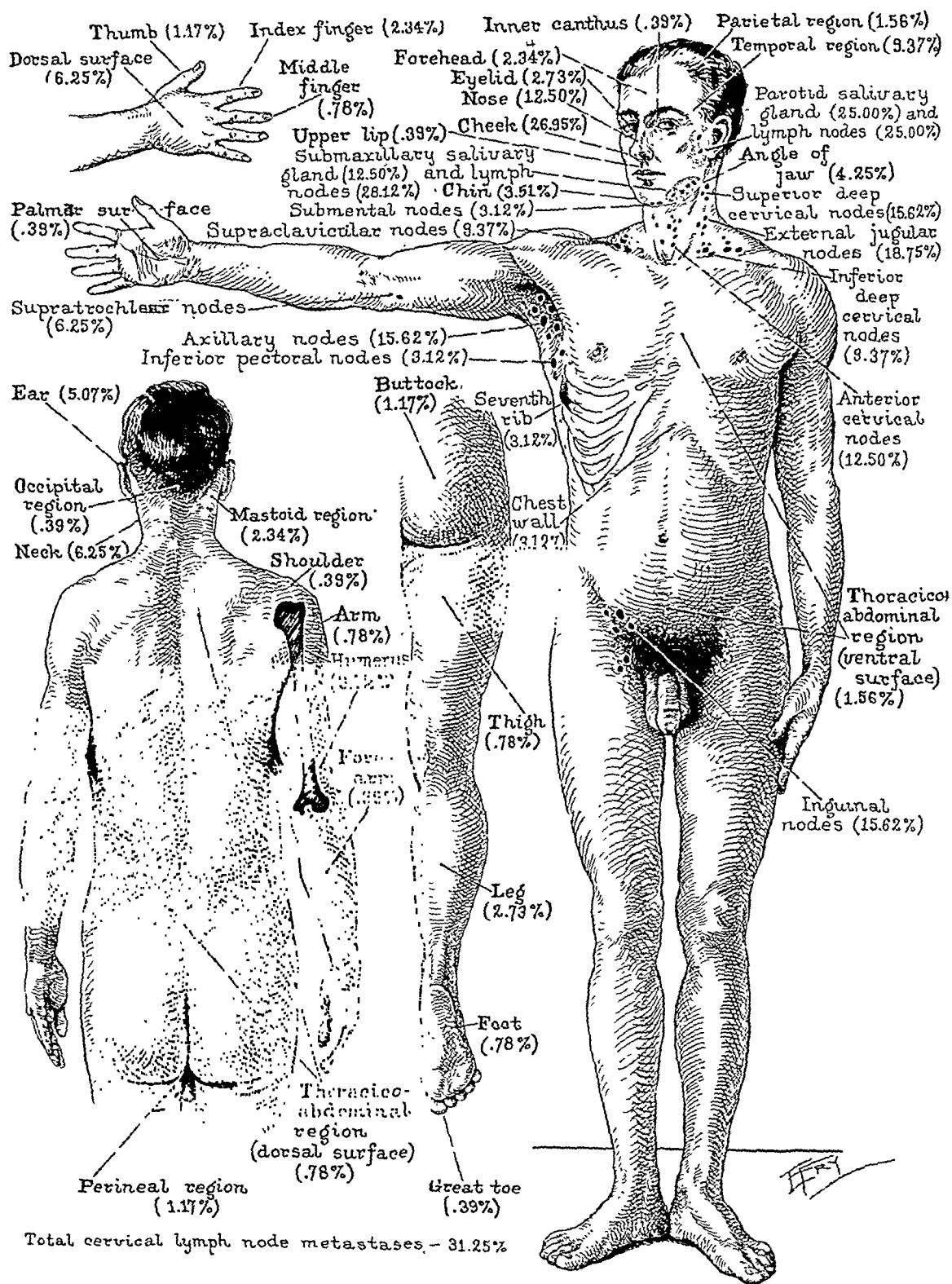


FIG. 19.—Percentages of points of origin in squamous-cell epithelioma of the skin and percentages of location of metastasis (location, dark letters; metastasis light letters).

in Grade 2, five and thirty-six hundredths years, and shortest in Grade 3, three and two hundredths years.

23. The average size of the lesion according to grade was largest in Grade 4, 5.4 cm., and smallest in Grade 1, 2.09 cm.

24. Fifty-one and seventy-seven hundredths per cent. of the patients operated on and traced are dead and 48.22 per cent. are alive.

25. Eighty-two and thirty-five hundredths per cent. of the living patients report good results, having been free from the disease on an average of seven and forty-four hundredths years.

26. Information received concerning the patients operated on who died, shows that 65.51 per cent. died of epithelioma.

27. Three (1.27 per cent.) of the patients who were operated on died before being dismissed from the Clinic; the actual operative mortality was 0.42 per cent.

28. Patients who were treated with pastes, plasters, and so forth, before entering the Clinic did not get such good total good results as those who were not so treated, 57.14 per cent. in the former group and 61.11 per cent. in the latter; the total poor results were 40 per cent. in the former group and 30 per cent. in the latter.

29. Ten and fifty-two hundredths per cent. of the patients with metastasis are living.

30. One of the two living patients who had metastasis reports a good result and one a fair result. In these patients the parotid lymph-nodes and salivary gland on one side only were involved.

31. No patient with cervical lymph-nodes or more than one group of any lymph-nodes involved has been reported living.

32. All the patients reported dead who had metastasis died of epithelioma.

33. Sixty per cent. of the patients operated on in whom no metastasis was demonstrated are living, all with good results, and 40 per cent. are dead.

34. Sixty-six and sixty-six hundredths per cent. of the patients reported dead who did not have metastasis died of epithelioma.

35. Fifty-three and fifteen hundredths per cent. of the patients operated on in whom no regional lymph-nodes or salivary glands were removed are living and 46.84 per cent. are dead; 81.35 per cent. of the living report good results

36. Fifty-four and seventy-six hundredths per cent. of the patients reported dead in whom no regional lymph-nodes or salivary glands were removed, died of epithelioma.

37. The total good results for the patients with metastasis are 6.66 per cent.; for those without metastasis, 77.77 per cent.; and for those in whom no regional lymph-nodes or salivary glands were removed, 66.33 per cent.

38. The total poor results without regard to grade for the patients with metastasis are 86.66 per cent.; for those without metastasis, 22.22 per

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cent.; and for those in whom no regional lymph-nodes or salivary glands were removed, 25.74 per cent.

39. The average duration of the lesion in the patients with metastasis was two and sixty-seven hundredths years; in those without metastasis, five and three hundredths years; and in those in whom no regional lymph-nodes or salivary glands were removed, four and seventy-eight hundredths years.

40. The average size of the lesion in the patients with metastasis was 6.3 cm.; in those without metastasis, 4.15 cm.; and in those in whom no regional lymph-nodes or salivary glands were removed, 3.08 cm.

41. The known causes of deaths from epithelioma were: Grade 1, 0; Grade 2, 61.29 per cent.; Grade 3, 85.71 per cent.; and Grade 4, 100 per cent.

42. The total good results for Grade 1 are 92.85 per cent.; Grade 2, 65.43 per cent.; Grade 3, 41.66 per cent.; and Grade 4, 0.

43. The total poor results for Grade 1 are 0; Grade 2, 25.92 per cent.; Grade 3, 54.16 per cent.; and Grade 4, 100 per cent.

TABLE I

Squamous-cell Epithelioma of the Skin: Two Hundred and Fifty-six Cases (12.8 Per Cent. of Two Thousand Cases of General Epithelioma) from November 1, 1904, to July 22, 1915, Mayo Clinic.

	No.	Per Cent.
Patients	256	
Males	205	80.078
Females	51	19.921
Age:		
Youngest patient		25.
Oldest patient		88.
Average age of patients		59.34
Occupation (males):		
Farmer	102	53.96*
Laborer	21	11.11
Merchant	11	5.81
Railroad employee	8	4.23
Physician:	6	3.17
Agent	4	2.11
Other occupations, 22 each under 2 per cent.....	37	19.57
Family history of malignancy	31	12.10
Previous lesion at site of cancer:		
Mole, wart, pimple, scab, ulcer, leucoplakia, crack, wen, blister, lump, etc.	131	51.17
History of injury	61	23.82
Burns, proportion of total injuries	15	24.59
X-ray burns, proportion of total burns	3	20.00
Average duration of lesion	4.8	years
Longest duration of lesion	35.0	years
Shortest duration of lesion	0.057	year
Greatest diameter	30.00	cm.
Average greatest diameter	3.854	cm.

*A large proportion of patients coming to the Mayo Clinic are from rural communities.

TABLE II

Location of the Lesion (Fig. 19)

	Cases	Per Cent.
Single lesion	247	96.48
Multiple lesions	9	3.51
Cheek	69	26.95
Nose	32	12.50
Temporal region	24	9.37
Neck	16	6.25
Hand (dorsal surface)	16	6.25
Ear	13	5.07
Angle of jaw	11	4.25
Chin	9	3.51
Eyelid	7	2.73
Leg	7	2.73
Forehead	6	2.34
Mastoid region	6	2.34
Index finger	6	2.34
Thoracico-abdominal region (ventral surface)	4	1.56
Parietal region	4	1.56
Thumb	3	1.17
Buttock	3	1.17
Perineal region	3	1.17
Thoracico-abdominal region (dorsal surface)	2	0.78
Arm	2	0.78
Middle finger	2	0.78
Thigh	2	0.78
Foot	2	0.78
Inner canthus	1	0.39
Occipital region	1	0.39
Upper lip (near nose)	1	0.39
Shoulder	1	0.39
Forearm	1	0.39
Hand (palmer surface)	1	0.39
Great toe	1	0.39

TABLE III

Treatment Elsewhere of Squamous-cell Epithelioma of the Skin

Non-surgical:

	No.	Per Cent.
One or more treatments with acids (carbolic, chromic, hydrochloric and nitric), alum (burnt), carbon dioxide, electricity, paste, potassium iodide, radium, Röntgen-ray (proportion of total non-operative methods of treatment, 50 per cent.) scarlet red and silver nitrate	72	28.12
Surgical:		
One or more operations	69	26.95
Surgical and non-surgical:		
Operations without treatment with acids, alum, carbon dioxide, etc...	50	19.53
Treatment with acids, alum, carbon dioxide, etc., without operation	53	20.70
Operation and treatment with acids, alum, carbon dioxide, etc.	103	40.23

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TABLE IV

Patients Operated on at the Mayo Clinic

Number of patients	236	(92.18 per cent. of 256)
Excision with knife immediately followed by cautery (one operation)	52	(22.03 per cent. of 236)
Excision with knife (one operation)	46	(19.49 per cent. of 236)
Block dissection of neck (unilateral) either alone or combined with other operations or methods of treatment before, at the same time, or after the block dissection was performed	9	(3.81 per cent. of 236)
Cautery (one operation)	8	(3.38 per cent. of 236)
Excision with cautery (one operation)	7	(2.96 per cent. of 236)
Excision with knife immediately followed by cautery (one operation) and later by skin graft (one operation)	7	(2.96 per cent. of 236)
Amputation of one or more fingers or of thumb and removal of regional lymph-nodes at the time of amputation or after amputation and either associated with or not associated with other operative or non-operative treatment before, at the time of, or after amputation..	6	(2.54 per cent. of 236)
Amputation of thigh or leg with or without removal of regional lymph-nodes and either associated or not associated with other operative or non-operative treatment before, at the time of, or after amputation	5	(2.11 per cent. of 236)
Amputation of arm, forearm, or hand with removal of regional lymph-nodes before or at the time of amputation, and either associated or not associated with other operative or non-operative treatment before, at the time of, or after the amputation	5	(2.11 per cent. of 236)
Excision with knife immediately followed by cautery (one operation) and followed later by cautery (one operation)	4	(1.69 per cent. of 236)
Cautery (two operations)	4	(1.69 per cent. of 236)
Block dissection of neck (bilateral) (two operations) accompanied by a complete evisceration of the left eye, excision of eyelids, and one supraclavicular lymph-node preceded by three excisions with knife immediately followed by cautery	1	(0.423 per cent. of 236)
Miscellaneous (various combinations of operations, radium and Röntgen-rays)	82	(34.74 per cent. of 236)
Inoperable	16	(6.25 per cent. of 236)
Operation refused after diagnosis had been made	4	(1.56 per cent. of 236)
Cases in which no lymph-nodes or salivary glands were removed	184	(77.96 per cent. of 236)
Cases in which lymph-nodes or salivary glands were removed (one or more groups)	52	(22.03 per cent. of 236)

TABLE V

Lymph-nodes and Salivary Glands Removed in Fifty-two Cases

	Cases	Per Cent.
Submaxillary lymph-nodes	23	44.23
Submaxillary salivary glands	23	44.23
External jugular-nodes	20	38.46
Superior deep cervical-nodes	15	28.84
Anterior cervical-nodes	12	23.07
Inferior deep cervical-nodes	12	23.07
Cervical lymph-nodes	21	40.38
Parotid salivary gland	10	19.21
Parotid lymph-nodes	9	17.30
Submental-nodes	9	17.30
Axillary-nodes	9	17.30
Inguinal-nodes	6	11.53
Supratrochlear-nodes	3	5.76
Supraclavicular lymph-nodes	3	5.76
Chest wall	1	1.92

TABLE VI

Pathologic Findings in Fifty-two Cases in which Lymph-nodes and Salivary Glands Were Removed

	Cases	Per Cent
No metastasis	20	38.46
Metastasis	32	61.53
Inguinal lymph-nodes alone (one side)	5	15.62
Axillary lymph-nodes alone (one side)	3	9.37
Parotid salivary gland and lymph-nodes (one side)	5	15.62
Submaxillary lymph-nodes alone (one side)	2	6.25
Submaxillary salivary gland and lymph-nodes (one side)	2	6.25
Right and left external jugular, submental, left submaxillary and supraclavicular lymph-nodes	1	3.12
External jugular, anterior cervical, superior and inferior deep cervical lymph-nodes (one side)	1	3.12
Supratrochlear and axillary lymph-nodes, lower and upper end of humerus, chest wall including seventh rib, axillary line (one side).	1	3.12
Miscellaneous (submaxillary lymph-nodes and salivary glands, parotid lymph-nodes and salivary glands, cervical, supraclavicular, supra-trochlear, axillary, and inferior pectoral lymph-nodes, alone or in various combinations (one side)	12	37.50

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TABLE VII

Metastasis in Thirty-two Cases (Fig. 19)

	Cases	Per Cent.
Submaxillary lymph-nodes	9	28.12
Parotid lymph-nodes	8	25.00
Parotid salivary gland	8	25.00
External jugular lymph-nodes	6	18.75
Superior deep cervical lymph-nodes	5	15.62
Axillary lymph-nodes	5	15.62
Inguinal lymph-nodes	5	15.62
Submaxillary salivary gland	4	12.50
Anterior cervical lymph-nodes	4	12.50
Inferior deep cervical lymph-nodes	3	9.37
Supraclavicular lymph-nodes	3	9.37
Supratrochlear lymph-nodes	2	6.25
Submental lymph-nodes	1	3.12
Inferior pectoral lymph-nodes	1	3.12
Chest wall	1	3.12
Lower and upper ends of humerus	1	3.12
Seventh rib, axillary line	1	3.12
Cervical lymph-node involvement	10	31.25

TABLE VIII

Grades in 256 Cases on a Basis of 1 to 4 According to Cellular Activity

	Cases	Per Cent.
Grade 1	21	8.20
Grade 2	178	69.53
Grade 3	44	17.18
Grade 4	13	5.07

Duration and Size of Epithelioma

	Grade 1 Years	Grade 2 Years	Grade 3 Years	Grade 4 Years
Longest duration	20.00	35.00	10.00	20.00
Shortest duration	0.08	0.05	0.16	0.10
Average duration	4.76	5.36	3.02	3.30
	Cm.	Cm.	Cm.	Cm.
Largest size	4.30	30.00	14.00	15.00
Smallest size	0.50	0.30	1.20	0.60
Average size	2.09	3.70	4.61	5.40
	Grade 1	Grade 2	Grade 3	Grade 4
Operable epithelioma	21	164	39	12
Inoperable epithelioma	0	11	4	1
	Grade 1	Grade 2	Grade 3	Grade 4
Operation refused after diagnosis had been made	0	3	1	0

TABLE IX

General Ultimate Results

Patients traced (operable, 141; inoperable, 5; refused operation, 1)	147	(57.42 per cent. of 256)
Patients operated on	141	
Patients living	68	(48.22 per cent.)
Good result	56	(82.35 per cent. of 68)
Fair result	9	(12.23 per cent. of 68)
Poor result	3	(4.41 per cent. of 68)

Duration of Life Since Last or Only Operation

	Good result Years	Fair result Years	Poor result Years
Longest	13.16	12.05	5.23
Shortest	4.31	5.50	0.15
Average	7.44	8.78	3.28
Patients dead	73	(51.77 per cent.)	

Deaths

Patients	79	(53.74 per cent. of 147)
Patients with operable epithelioma	73	(92.40 per cent. of 79)
Patients with inoperable epithelioma	5	(6.32 per cent. of 79)
Patients who refused operation after diagnosis had been made	1	(1.26 per cent. of 79)

Cause of Death of Patients Operated on: Data from Relative, Home Physician, or Pathologic Records of the Clinic

	No.	Per Cent.
Known cause	58	
Epithelioma	38	65.51
Old age	4	6.89
Heart disease	4	6.89
Paralysis	3	5.17
Pneumonia	2	3.44
Arteriosclerosis	1	1.72
Acute gastritis	1	1.72
Carcinoma of pancreas	1	1.72
General infection	1	1.72
Carcinoma of prostate and pneumonia	1	1.72
Influenza	1	1.72
Tuberculosis	1	1.72
Unknown	15	

Cause of Death of Patients Operated on Who Died at the Clinic

Epithelioma and pneumonia (1.28 years after operation) ..	1	
Carcinoma of prostate and pneumonia (0.47 years after operation)	1	
Epithelioma and shock (0.027 year after operation)	1	
<hr/>		
Total	3	(1.27 per cent. of 236)
Actual operative mortality	1	(0.42 per cent. of 236)

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TABLE X
Patients Operated on, Treated with Pastes, Plasters, Acids, Etc., Before Entering the Clinic

	Grade 1	Grade 2	Grade 3	Grade 4	
Patients living					36 (54.54 per cent. of 66)
Good result	2 (10.52 per cent. of 19)	14 (73.68 per cent. of 19)	3 (15.78 per cent. of 19)		21 (58.33 per cent. of 36)
Fair result		1 (100 per cent. of 1)			
Poor result					
Patients dead			1 (100 per cent. of 1)		
Good result		1 (100 per cent. of 1)			15 (41.66 per cent. of 36)
Poor result		9 (69.23 per cent. of 13)	3 (23.07 per cent. of 13)	1 (7.69 per cent. of 13)	
Cause unknown	1				
<i>Total Results</i>					
Good (patients recovered from epithelioma and are living or recovered from epithelioma and died of other cause)					20 (57.14 per cent. of 35)
Fair (patient living with slight recurrence)					1 (2.85 per cent. of 35)
Poor (patients living with no improvement or died of epithelioma)					14 (40.00 per cent. of 35)
No information received					30 (45.45 per cent. of 66)

TABLE XI
Patients Operated on, Not Treated with Pastes, Plasters, Acids, Etc., Before Entering the Clinic

	Grade 1	Grade 2	Grade 3	Grade 4	
Patients living					104 (61.17 per cent. of 170)
Good result	4 (11.11 per cent. of 36)	27 (75 per cent. of 36)	5 (13.88 per cent. of 36)		46 (44.23 per cent. of 104)
Fair result	2 (25.00 per cent. of 8)	5 (62.50 per cent. of 8)	1 (12.50 per cent. of 8)		
Poor result		2 (100 per cent. of 2)			
Patients dead					
Good result	6 (31.57 per cent. of 19)	11 (57.89 per cent. of 19)	2 (10.52 per cent. of 19)		58 (55.76 per cent. of 104)
Poor result		11 (44.00 per cent. of 25)	8 (32.00 per cent. of 25)	6 (24.00 per cent. of 25)	
Cause unknown	2				
<i>Total Results</i>					
Good (patients recovered from epithelioma and are living, or recovered from epithelioma and died of other causes)					55 (61.11 per cent. of 90)
Fair (patients living with slight recurrence)					8 (8.88 per cent. of 90)
Poor (patients living with no improvement or died of epithelioma)					27 (30.00 per cent. of 90)
No information received					66 (38.82 per cent. of 170)

TABLE XII
Patients with Metastasis Operated on with Removal of Regional Lymph-nodes or Salivary Glands

Information received.	Grade 2	Grade 3	Grade 4
Patients living.....			19 (59.37 per cent. of 32)
Good result *.....	1 (100 per cent. of 1)		
Fair result *.....		1 (100 per cent. of 1)	2 (10.52 per cent. of 19)
Patients dead.....			
Poor result.....	4 (30.76 per cent. of 13)	4 (30.76 per cent. of 13)	17 (89.47 per cent. of 19)
Cause unknown.....	2	2	5 (38.46 per cent. of 13)
<i>Total Results</i>			
Good (patient recovered from epithelioma).....			1 (6.66 per cent. of 15)
Fair (patient living with slight recurrence).....			1 (6.66 per cent. of 15)
Poor (patients died of epithelioma).....			13 (86.66 per cent. of 15)
<i>Cause of Death</i>			
Epithelioma.....			13 (100 per cent. of 13)
No information received.....			13 (40.62 per cent. of 32)
* In the patient who reported a good result and in the one who reported a fair result, the parotid lymph-nodes and salivary glands on only one side were involved.			

TABLE XIII
Patients Without Metastasis Operated on With Removal of Regional Lymph-nodes or Salivary Glands

Information received.	Grade 1	Grade 2	Grade 3	Grade 4
Patients living.....				10 (50 per cent. of 20)
Good result.....	2 (33.33 per cent. of 6)	3 (50.00 per cent. of 6)	1 (16.66 per cent. of 6)	6 (60 per cent. of 10)
Patients dead.....				
Good result.....				4 (40.00 per cent. of 10)
Poor result.....	1 (100 per cent. of 1)	2 (100 per cent. of 2)		
Cause unknown.....	1	1		
<i>Total Results</i>				
Good (patients recovered from epithelioma and are living or recovered from epithelioma and died of other cause)				7 (77.77 per cent. of 9)
Poor (patients died of epithelioma).....				2 (22.22 per cent. of 9)
<i>Cause of Death</i>				
Epithelioma.....				2 (66.66 per cent. of 3)
Heart disease.....				1 (33.33 per cent. of 3)
No information received.....				10 (50.00 per cent. of 20)

TABLE XIV
Patients Operated on Without Removal of Regional Lymph-nodes or Salivary Glands

Information received.....	Grade 1	Grade 2	Grade 3	Grade 4	
Patients living.....					111 (60 per cent. of 185)
Good result.....	5 (10.41 per cent. of 48)	35 (75.00 per cent. of 48)	7 (14.58 per cent. of 48)		59 (53.15 per cent. of 111)
Fair result.....	1 (12.50 per cent. of 8)	7 (87.50 per cent. of 8)			
Poor result.....		2 (66.66 per cent. of 3)	1 (33.33 per cent. of 3)		
Patients dead.....					52 (46.84 per cent. of 111)
Good result.....	7 (36.84 per cent. of 19)	10 (52.63 per cent. of 19)	2 (10.52 per cent. of 19)		
Poor result.....		14 (60.86 per cent. of 23)	7 (30.43 per cent. of 23)	2 (8.69 per cent. of 23)	
Cause unknown.....	2	8			
<i>Total Results</i>					
Good (patients recovered from epithelioma and are living or recovered from epithelioma and died of other cause)					67 (66.33 per cent. of 101)
Fair (patients living with slight recurrence)					8 (7.92 per cent. of 101)
Poor (patients living with no improvement or died of epithelioma)					26 (25.74 per cent. of 101)
<i>Cause of Death</i>					
Epithelioma.....					23 (54.76 per cent. of 42)
Old age.....					4 (9.52 per cent. of 42)
Paralysis.....					3 (7.14 per cent. of 42)
Heart disease.....					3 (7.14 per cent. of 42)
Pneumonia.....					2 (4.76 per cent. of 42)
Acute gastritis.....					1 (2.38 per cent. of 42)
Arteriosclerosis.....					1 (2.38 per cent. of 42)
Carcinoma of pancreas.....					1 (2.38 per cent. of 42)
Carcinoma of prostate and pneumonia.....					1 (2.38 per cent. of 42)
General infection.....					1 (2.38 per cent. of 42)
Influenza.....					1 (2.38 per cent. of 42)
Tuberculosis.....					1 (2.38 per cent. of 42)
No information received.....					74 (40.00 per cent. of 185)

TABLE XV
Patients With Metastasis and Patients Without Metastasis Operated on and Patients in Whom no Regional Lymph-nodes or Salivary Glands Were Removed

	Grade 1	Grade 2	Grade 3	Grade 4
With metastasis.....		11 (34.2 per cent. of 32)	12 (37.5 per cent. of 32)	9 (28.12 per cent. of 32)
Without metastasis.....	2 (10 per cent. of 20)	14 (70.00 per cent. of 20)	4 (20.00 per cent. of 20)	
Without removal of regional lymph-nodes or salivary glands.....	19 (10.32 per cent. of 184)	139 (75.64 per cent. of 184)	23 (12.5 per cent. of 184)	3 (1.63 per cent. of 184)
<i>Duration of Lesion Before Patient's Examination at the Clinic</i>				
With metastasis.....		Longest, 15 years	Shortest, 0.10 year	Average, 2.67 years
Without metastasis.....		Longest, 20 years	Shortest, 0.8 year	Average, 5.3 years
Without removal of regional lymph-nodes or salivary glands.....		Longest, 35 years	Shortest, 0.05 year	Average, 4.78 years
<i>Size of Lesion at the Time of Patient's Examination at the Clinic</i>				
With metastasis.....		Largest, 30 cm.	Smallest, 1.5 cm.	Average, 6.3 cm.
Without metastasis.....		Largest, 15 cm.	Smallest, 1.5 cm.	Average, 4.15 cm.
Without removal of regional lymph-nodes or salivary glands.....		Largest, 30 cm.	Smallest, 0.3 cm.	Average, 3.08 cm.

TABLE XVI

Duration of Life After Operation of Patients With Metastasis

	Grade 1	Grade 2	Grade 3	Grade 4	I4 (43.75 per cent. of 32)
Information received.....					
Patients living.....					
Good result.....		I			2
Fair result.....		I			4.8 years
Patients dead.....					11.8 years
Poor result.....		4	3	5	12
		Years	Years	Years	Average of all grades
Longest.....		1.28	0.50	2.96	2.96
Shortest.....		0.15	0.31	0.027	0.027
Average.....		0.68	0.41	1.58	0.98
No information received.....					18 (46.25 per cent. of 32)

TABLE XVII
Duration of Life After Operation of Twenty Patients Without Metastasis

Information received.....	Grade 1	Grade 2	Grade 3	Grade 4	Average of all Grades
Patients living.....	2	3	1	6	8 (40.00 per cent. of 20)
Good result.....	2	3	1	6	8 (40.00 per cent. of 20)
Longest.....	7.26	7.97	8.90		8.90
Shortest.....	6.01	6.33			6.01
Average.....	6.63	7.18			7.29
Patients dead.....					
Good result.....					
Poor result.....					
Longest.....					
Shortest.....					
Average.....					
No information received.....					12 (60.00 per cent. of 20)

TABLE XVIII

Duration of Life of Patients Operated on Without Removal of Regional Lymph-nodes or Salivary Glands

	Grade 1	Grade 2	Grade 3
Patients living.....			
Good result.....	5 Years	37 Years	7 Years
Longest.....	6.49	13.14	10.88
Shortest.....	4.93	4.31	6.04
Average.....	5.70	7.74	7.59
Fair results.....	1 Years	7 Years	
Longest.....	1.59	12.50	
Shortest.....		5.50	
Average.....		8.38	
Poor result.....		2 Years	1 Years
Longest.....		5.23	0.15
Shortest.....		4.46	
Average.....		4.84	
<i>Duration of Life of Patients of All Grades</i>			
Patients living:	Good result	Fair result	Poor result
Longest.....	13.14 years	12.50 years	5.23 years
Shortest.....	4.31 years	1.59 years	0.15 year
Average.....	7.51 years	8.40 years	3.73 years
Patients dead (not of epithelioma).....	6 years	10 years	2 years
Good result			
Longest.....	8.16 years	9.02 years	6.40 years
Shortest.....	0.43 year	0.26 year	5.34 years
Average.....	3.96 years	3.55 years	5.87 years
Poor result.....	13 years	7 years	2 years
Longest.....	3.61 years	1.95 years	0.98 year
Shortest.....	0.26 year	0.05 year	0.58 year
Average.....	1.45 years	0.93 year	0.78 year
<i>Duration of Life After Operation of Patients of All Grades</i>			
	Good result	Poor result	Average of all grades
	Years	Years	Years
Longest.....	9.02	3.61	9.02
Shortest.....	0.26	0.05	0.05
Average.....	3.92	1.22	2.45

SQUAMOUS-CELL EPITHELIOMA OF THE SKIN

TABLE XIX
Results Following Operation

	Grade 1		Grade 2		Grade 3		Grade 4	
Information received.....	16	(76.19 per cent. of 21)	92	(56.09 per cent. of 164)	26	(66.66 per cent. of 39)	7	(58.33 per cent. of 12)
Patients living.....	8	(50.00 per cent. of 16)	50	(54.34 per cent. of 92)	10	(38.46 per cent. of 26)		
Good result.....	7	(87.50 per cent. of 8)	41	(82.00 per cent. of 50)	8	(80.00 per cent. of 10)		
Fair result.....	1	(12.50 per cent. of 8)	7	(14.00 per cent. of 50)	1	(10.00 per cent. of 10)		
Poor result.....			2	(4.00 per cent. of 50)	1	(10.00 per cent. of 10)		
Patients dead.....	8	(50.00 per cent. of 16)	42	(45.65 per cent. of 92)	16	(61.53 per cent. of 26)	7	(100 per cent. of 7)
Good result.....	6	(100 per cent. of 6)	12	(38.70 per cent. of 31)	2	(14.28 per cent. of 14)		
Poor result.....			19	(61.29 per cent. of 31)	12	(85.71 per cent. of 14)	7	(100 per cent. of 7)
Not stated.....	2		11		2			
Total good result (patients re-covered from epithelioma and are living or recovered from epithelioma and died of other cause) 13	(92.85 per cent. of 15)	53	(65.43 per cent. of 81)	10	(41.66 per cent. of 24)			
Total fair result (patients living with slight recurrence).....	1 (7.14 per cent. of 14)	7	(8.64 per cent. of 81)	1	(4.16 per cent. of 24)			
Total poor result (patients living with no improvement or died of epithelioma).....		21	(25.92 per cent. of 81)	13	(54.16 per cent. of 24)	7	(100 per cent. of 7)	
Total result not stated.....	2	11		2				

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PAINLESS HYPODERMOCLYSIS

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THE vicarious administration of water has been revolutionized in my service by the employment of local anæsthesia from the beginning to the end of the procedure. It seems remarkable, in view of the perfection of local anæsthesia technic everywhere in minor surgery, that we have been content with a hypodermoclysis which must in most instances have seemed to the patient little short of brutal.

Sporadic attempts have been made to minimize the discomfort attending some of the steps in the operation, but I submit herewith a technic which has on many occasions worked so well that the patient has not at any time paid the slightest attention to the introduction of comparatively large amounts of water. I will grant in passing that nothing is claimed in the rare instances where nervous patients, objecting to local anæsthesia in any form, have forcibly opposed its use.

A very extensive employment of infiltration anæsthesia led to the suggestion of introducing very *dilute novocaine* where we had been in the habit of using straight salt solution, or what may be better, distilled water. This came about quite naturally after using in a very few instances abnormally large quantities of $\frac{1}{2}$ per cent. novocaine solution, and reflecting that the introduction of a few 100 c.c. of fluid into a partially dehydrated patient had to some extent offset the possible risk of employing what may well be considered a toxic dose of the novocaine which seemed indispensable to the performance of a much-needed surgical operation.

I will state in passing that I have never observed dangerous toxic symptoms following the employment of novocaine, although I have frequently far exceeded what is commonly given as the maximum dose. In the evolution of this method we gave as hypodermoclysis gradually increasing amounts of fluids, in which from time to time the percentage of novocaine was cut down first from $\frac{1}{2}$ to $\frac{1}{4}$, then to $\frac{1}{8}$, and finally to $\frac{1}{16}$ of 1 per cent., without the anæsthetic value of the drug being appreciably diminished. I am perfectly well aware that so distinguished an authority as Braun writes that he has never been able to use novocaine successfully in a concentration as low as $\frac{1}{4}$ of 1 per cent. This has not, however, been in accordance with my own experience, or that of Allen, Farr, Wennerman, *et al.*, who are making very extensive use of this substance. Now I do not wish to be understood as advocating $\frac{1}{8}$ or $\frac{1}{16}$ per cent. novocaine solution in the performance of surgical operations, but this I can state conclusively that it suffices for the introduction of fluid under the skin.

It was but a further step in the technic to add sterile morphine to the hypodermoclysis fluid. Many a patient requires this drug for the same

manifestations which indicate hypodermoclysis, and surely the morphine effect is an aid in combating any possible discomfort attending the introduction of fluid under the skin. The dosage is, of course, to be determined by the rapidity of inflow, age and condition of the patient, and all the other elements which ordinarily enter into the employment of this, to the surgeon, valued drug.

Where hypodermoclysis is used in any of the conditions, such as shock, hemorrhage, etc., which are attended by a fall of blood-pressure, we are accustomed to add adrenalin to the fluid. A constant inflow of this substance is highly desired, since its destruction is so rapid as to make the effect of each small dose of short duration.

The use of freshly distilled water, instead of salt solution in my service, commenced in 1915, at the suggestion of my then house surgeon, Dr. O. F. McKittrick. It occurred to him that the introduction of sodium chloride solution in large amounts led to an undesirable salt concentration in the body. He experimented in every way, after discussing any possible risk of employing water, with Doctor Erlanger, and obtained most gratifying results. By comparing water and salt solution introduced at the same time in the two axillæ of the same individual he found that water was absorbed more rapidly than the other fluid. He used as high as 10,000 c.c. in three days and in only a few instances noted a drawback which might have happened if salt solution had been used, *viz.*, an extensive imbibition of the subcutaneous tissues took place in jaundiced individuals.

The choice of a method of vicariously administering fluid becomes a matter of even greater importance perhaps than was formerly supposed, to one who reads the astonishing results obtained by Balcar, Sansun and Woodyatt in their article entitled "Fever and the Water Reserve of the Body," which appears in the *Archives of Internal Medicine* for July, 1919. As they suggest, no doubt salts do hold water in association with themselves, which may be an argument for the administering of sterile water instead of salt solution under the skin. However this may be, I am not at all sure that sterile water, which is not an *isotonic* material, can always be used without undesirable local effects. On many occasions, as above noted, it has served me well, but at other times its use has been followed by tissue changes, which, however, it is only fair to state in comparison, one occasionally sees when salt solution is employed. In this connection, I am glad to be able to quote verbatim a communication received recently from Dr. Evarts A. Graham: "For some time I have been using glucose solutions hypodermically in concentration of from 2 to 5 per cent. A solution of about 3 per cent. is nearly isotonic with the blood, and, as a matter of fact, it is possible to exceed this amount considerably without damage, because of the rapid disappearance of the glucose in the tissues. Glucose solutions hypodermically have a decided advantage over ordinary saline solutions because, in the first place, glucose is, of course, a food which is readily utilized by the body; in the second place, glucose is a very efficient anti-ketogenic substance so that it is of great value in combating any existing acidosis which is usually present to some degree

PAINLESS HYPODERMOCLYSIS

in conditions which require the injection of fluids, such as post-operative conditions of all kinds, infections, inanition, etc.; in the third place, such a solution has the decided advantage of liberating 'free' water gradually to the tissues as the glucose is burned by the body."

The apparatus we use is simplicity itself, consisting of the ordinary 700 c.c. glass drip bottle, a rubber tube one yard in length, controlled by a screw clamp, and a slender, long needle. This is substantially the apparatus commonly used by hospitals for the introduction of water into the rectum, with the exception that we have, for use, cut out the drop sight feed attachment, since we make use of a local anæsthesia agent, and the rate of inflow into desensitized tissues does not matter particularly. The inflow is regulated according to the rate of absorption, the water-logged area never being allowed to become unreasonably tight, and thus threaten tissue pressure necrosis. The needle sometimes has to be withdrawn, cleaned out with a wire and reinserted if it becomes plugged.

We find the flank midway between the lower ribs and the prominent upper curve of the ilium to be the site of election, since less subsequent damage has occurred here than elsewhere. We no longer inject fluid under the breast of a woman, because she is likely to experience a great deal of pain every time she takes a breath for some hours after the anæsthesia effect of the fluid has worn off. The same thing is true with movement of the upper arm if a fluid has been injected about the axillæ or the pectoral muscles. Furthermore, the cavity of the axilla contains structures which are by no means indifferent to a long needle, wielded by an inexperienced nurse or a careless interne. If worst comes to worse, and the avoidable as well as inexcusable accidental infection occurs, this is distinctly more to be dreaded in either of the three regions enumerated than it is under the skin of the flank, where surgical treatment is a comparatively simply matter.

The introduction of the needle is made painless by an ethyl chloride spray on the skin. After the needle has been introduced, the region is covered by a small square of gauze, held in place with adhesive, and the surgical aspect of the little procedure is complete. Then it remains only for a nurse, or the patient himself, if he be a very reasonable individual, to control the rate of inflow.

In some few instances the ordinary sight drip apparatus has been employed, and forty to eighty drops admitted per minute, but any form of graduated clamp may be used and opened or closed at will. It may be noted in passing, that plethora is a possibility here, and a patient who is receiving large amounts of fluid should be examined occasionally for evidences of cardiac dilatation or pulmonary œdema.

Our three vital bodily needs are oxygen, with which we cannot dispense for more than a few minutes; water, which we can go without for a few hours, and food for which an urgent need becomes apparent after a few days. These three essentials to a vegetative existence are of such paramount importance that a little more detailed discussion of water in its relation to the human organism cannot fail to be of interest. An intake and output record

must be kept wherever there is any difficulty about the ingestion of fluids or any great alteration in its output. This goes without saying in the routine of a well-regulated hospital.

Thirst is not altogether a matter of the amount of fluid in the tissues, hence one must not promise too much for hypodermoclysis as an immediate reliever of this aggravating manifestation. There is only one way to relieve thirst, as such, but a reasonable individual will try hard to bear this form of torture if he be assured that his tissues are really getting plenty of fluid, although none is swallowed. There is, of course, a great variety of reasons why fluid cannot be taken in the normal manner. An individual who is vomiting usually does better if his stomach is given a rest, no matter what the cause may be. There can be no argument regarding the advisability of keeping fluids away from one suffering from mechanical obstruction of the digestive apparatus. It is in many instances better to keep the gatroenteric tract at rest for a time after it has been the subject of surgical or other forms of trauma, and surely no fluid may be swallowed if the spread of a peritoneal infection is to be limited by intestinal quiet.

There are indeed many avenues for the introduction of fluid into the human body. The intravenous administration has, of course, a place in our therapeutics, and in many cases has been used with great success for drop-by-drop saline. This requires, however, a certain degree of surgical skill, and is perhaps not generally applicable. The gall-bladder has been employed with great success by McArthur, Matas, *et al.*, but is available in but a small percentage of individuals who have to have fluid. The intraperitoneal method is used largely by pediatricians, but seems not to have been generally employed in adults. Fluids have been introduced into arteries, but I believe this phase of the subject can be dismissed without any discussion. Some fluid is absorbed from the pleura, but no one would think of utilizing that membrane for the introduction of water under ordinary circumstances. It is not at all difficult to introduce a small cannula into the intestine during an abdominal operation, still, the intestine is not always available, and the risk of sepsis would probably offset to a certain extent any value attached to the method.

Proctoclysis is widely used, and was, up to about two years ago, supposed by me to be a procedure of considerable value, usefulness, although *disturbing to my patients*. I gave it up because painstaking nurses finally convinced me that the fluid was not usually retained, and I would take the liberty of suggesting that those who think it of value administer it a few times *in person* and watch the results before continuing to use it as a routine procedure.

Hypodermoclysis has given me greater satisfaction than has any other method of introducing fluids vicariously, still, it is not ideal, nor is any other procedure but drinking. When one orders hypodermoclysis, he does so with the full knowledge that infection or tissue devitalization is possible, and that the region affected is quite likely to remain very tender for two or three days, but of one thing he can now be reasonably certain, *viz.*, that a continuous inflow of $\frac{1}{16}$ per cent. novocaine can be maintained with most patients, as long as indicated, without causing discomfort or toxic symptoms.

REGIONAL ANÆSTHESIA*

A SHORT REVIEW OF THE GENERAL PRINCIPLES

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SPECIAL LECTURER ON REGIONAL ANÆSTHESIA

INDUCING local or regional anæsthesia for minor operations has reached a high degree of perfection and has proved successful even when dealing with the majority of unprepared patients, that is, patients who have had no preliminary psychic treatment. These patients generally volunteer their consent to the method on the advice of the surgeon in whom they have placed all their confidence. Very few resist after they have been made to understand its meaning and the real benefit they will derive from it. But, whenever a major operation is contemplated, the question arises whether or not the patient is likely to be a good subject for local or regional anæsthesia. Patients who are able to go through the various steps of a major operation without psychic distress usually come from localities where the method is in common use; they have been educated to the method either by friends or relatives, and a great many of them go to the surgeons who are known to use local and regional anæsthesia as a routine procedure. In countries where the majority of the surgical work is done under general anæsthesia, however, every patient needs preliminary psychic treatment and education in the hospital.

Doctor Crile's work on the local method of anæsthesia has led him to conclude that by "blocking nerve conduction local anæsthetics protect the brain from the effects of local operative injury, but they do not protect the brain against destructive psychic strain. Inhalation anæsthetics exclude the psychic stimulation of the brain cells, but do not exclude the operative stimulation."¹ Conditions in human beings were considered to be similar to those demonstrated in animals by these laboratory findings, and, with a view to reducing operative shock to its minimum, Crile established what he rightly calls "anoci-association." The details of the technic of anoci-association are very delicate and elaborate and require special training of the patient as well as of every one on the hospital staff, including the surgeon who needs special education in the application of local and regional anæsthesia in individual cases and special training in the operative procedures.

Some patients go to the surgeon in a state of such lowered resistance that it is often a question whether or not it would be justifiable to incur the risks of a general anæsthesia. They are frequently auto-intoxicated to such an extent that the normal metabolism and the oxygenation of the

* Presented before the Staff of the Mayo Clinic and the Faculty and Fellows in The Mayo Foundation, Rochester, Minn., October 6, 1920.

blood are greatly altered, thereby interfering with the essential requisites of any general anæsthesia. In such cases, the advantages of regional anæsthesia are obvious, since its main effects are limited to a relatively small region of the body, leaving intact the central nervous system, on the integrity of which depends the continuance of all the vital functions.

The degree of pain is not proportional to the intensity of the trauma. Individual differences are well marked and depend on many factors, among which the emotional element plays the chief part. Nervous excitement, especially that due to apprehension, may be so great in some patients as to interfere even with the necessary manipulations in the local and regional procedures, and make it a difficult task to carry out the steps of even a simple technic. Some patients of phlegmatic temperament have confidence in the operator and are satisfied with the promise that there will be no pain, but many others become restless and uneasy and find thirty minutes spent on the operating table a severe trial. Although they actually experience no pain, their consciousness that the operation is being performed is the principal drawback of the method. To such patients a slight touch is often interpreted as pain; a few whiffs of ether generally suffice to calm them and allow the operation to proceed without disturbance. Very few of them require ether in quantities that deprive them of the benefit of their local anæsthesia. A third category of patients accept or even ask to be anæsthetized locally, but as soon as they reach the operating room faint or ask to be etherized. It is therefore advisable, as a general rule, to blunt the consciousness of the patients and for this purpose scopolamine and morphine have proved to be most effective.

A solution containing scopolamine 0.0002 gm. and morphine 1 cg. is injected one hour before the anæsthesia is induced. The injection of a smaller dose or of the same dose at a later stage seems to act on some patients as an excitant rather than as a sedative. After the injection, the patient should be kept quiet in a darkened room; he should be wheeled into the operating room on a stretcher and handled as gently as possible and every unnecessary stimulation avoided. This injection is not meant to produce a twilight sleep during which rough handling might be carried out without disadvantage, but to abolish fear, anxiety or uneasiness and determine a more placid state of mind; and the most characteristic features of its results are the pleasant mood and obedient behavior of these patients in marked contrast to many others not so treated. Morphine may be replaced by pantopon, sedol or siderol, which are opium alkaloids. Good results may be obtained with a hypodermic injection of:

Morphine hydrochlor.	0.01 gm.
Scopolamine	0.0002 gm.
Sparteine sulphate	0.05 gm.
Strychnine sulphate	0.002 gm.

Scopolamine and morphine congest the brain and sparteine stimulates the heart. Strychnine acts on the cord and checks the action of any

impurities contained in the novocaine solution; it also helps to keep the respiratory centres at work and support the blood-pressure. There are no disagreeable symptoms with scopolamine, provided our average dose is not overlooked. Nausea and vomiting have been observed in some cases even with morphine alone and especially when it is injected too late. I do not think that this can be attributed to scopolamine, but I am prone to believe that it is peculiar to certain kinds of neurotics or is due to a reflex in the course of abdominal operations or pelvic work with the patient in the Trendelenburg position.

Novocaine solutions are adopted almost universally for local and regional anæsthesia. Cocaine was used by Reclus and Schleich in the early days of the method, but these pioneers rejected it as soon as novocaine was discovered. Novocaine is about ten times less toxic than cocaine, but the analgesia is delayed and of relatively short duration, so that some adrenalin must be added to the solution in order to accelerate its effects and render it almost as active as cocaine. Other substances may be added for the same purpose: calcium chloride, sodium bicarbonate, sodium sulphate, and gelatine have been tried with varying and indefinite results. Twenty to thirty drops of a 1:1000 solution of adrenalin is the usual dose in 100 c.c. of novocaine solution, irrespective of the strength of the solution; this dose should be diminished by half for children and old persons. Fresh solutions of adrenalin are the most active, but I am not prepared to say that they are the safest, inasmuch as the toxic symptoms reported by a few observers might be accounted for by the presence of impurities in the novocaine solution.

For local and regional anæsthesia it is sometimes necessary to inject large quantities of fluid, and this is of appreciable disadvantage in regions where the scarcity of loose tissues does not permit of a fair infiltration without marked distortion of the anatomic features of the operative area, aside from the sharp pain from a sudden and marked œdema. With a view to reducing these quantities of fluid, a small proportion of cocaine was added to the novocaine, in order to obtain a reinforcement of the latter. A solution containing 10 cg. of cocaine and 90 cg. of novocaine per 100 c.c. in doses of from 100 c.c. to 125 c.c. produced symptoms of intoxication (nervous excitement, cardiac distress, labored breathing, pallor of the face, and collapse; in some cases the effects were limited to talkativeness, shouting and singing). The reduction in the amount of liquid injected was negligible, but the duration of anæsthesia was increased. A solution containing only cocaine (0.5 per cent.) gave rise to even graver symptoms when about 40 c.c. had been injected. On the other hand, 100 c.c. to 125 c.c. of a 1:100 pure novocaine and adrenalin solution (25 drops per 100 c.c.) injected systematically in a series of more than 1000 cases did not produce any untoward effects, and the duration of the anæsthesia proved sufficient even for the longest operations. I have thus been led to believe that pure novocaine adrenalin solutions are the safest;

novocaine-cocaine mixtures are dangerous; *and pure cocaine solutions should never be used in regional anæsthesia.*

The strength of the solutions varies with the technic; 0.5 per cent. is used for subcutaneous infiltration; 1 per cent. for paravertebral, caudal and muscular injections and for the anæsthesia of the head, hand, and foot; 2 per cent. for caudal injections and for blocking the brachial plexus and the great nerve trunks; and 5 per cent. in the surgery of the eye.

Needles should be long, thin, and flexible; steel nickel-plated needles are the best, and they should exactly fit the syringe. Straight needles are satisfactory, provided their attachment on the syringe is excentric, so as to allow injections to be made parallel with the skin surface. Special syringes with suitable wings for the fingers offer a better grasp than the ordinary Luer. Glass syringes should be preferred to all metal ones, because it is highly desirable to control their contents at any stage of the procedure; the plunger should be loose but air tight.

Gentleness is the first requisite of the anæsthetist. Before anæsthesia is begun, the patient should be warned that he will feel a few light pin-pricks, but that all the subsequent operative manœuvres will be painless, although the sense of touch and pull will not be abolished. If he is unwilling to be conscious of what is going on, his ears should be plugged with cotton and his eyes bandaged. The anæsthetist should handle his needle and his patient with equal dexterity. His knowledge in anatomy should be as perfect as possible, especially so far as nerve distribution is concerned. He should know how best to gain access to the nerves he wishes to anæsthetize. Needles and syringes should be tested before use, so as to make sure that they are in good working order. Anæsthetic wheals should be made wherever the skin is to be punctured. Bones serving as deep landmarks should be approached lightly with the needle, since the periosteum is very sensitive; rough contact with the framework usually bends the point of the needle into a hook which tears through the tissues as it is withdrawn. Infiltration should be slow, steady, and continuous as the needle advances in the subcutaneous tissue, as well as when it is withdrawn. The needle should never be previously attached to the syringe when it has to be introduced in the vicinity of large blood-vessels, and time should always be allowed before the syringe is fitted on, so as to ascertain that the point of the needle is not lying in the lumen of a blood-vessel. The presence of blood prompts the slight withdrawal of the needle until the flow ceases, and, if the needle has to be introduced more deeply, its direction should be changed. A small hæmatoma caused by the accidental wounding of any blood-vessel by the fine needle is of no importance; it might, however, interfere with the results of anæsthesia. It is advisable to aspirate before injecting. The injection should be made slowly and the aspiration test renewed now and again. The injection of a few drops of solution into the pleural cavity is immediately followed by coughing; injection into the lung is usually announced by

the patient as a bad taste. These small accidents are the result of poor technic; they are not dangerous, but they should be avoided. Paraneural or extraneural infiltration should be preferred to intraneural injection.

The surgeon should wait at least ten minutes to obtain the full anæsthetic effects. He should inspire his patient with confidence, make sure that the latter is lying at ease on a soft cushion, with as little restraint as possible, so that he may undergo the operation with the minimum of discomfort. The patient should not be told when the operation begins; it should be the duty of a trained nurse to talk to him from beginning to end, diverting his attention to pleasant topics. Sharp instruments should be used; cutting with the scalpel should be preferred to snipping with the scissors. On no account should the tissues be torn through or bruised by rough handling. Retractors should be introduced lightly and opened out gradually. Pulls on the viscera should be light and gradual. The organs should not be unnecessarily drawn out of the abdominal wound. Blood-vessels and pedicles should be clamped and ligated with as little traction as possible. Incisions should always be made longer than in operations with general anæsthesia, thus exposing more freely the deep layers and avoiding unnecessary trauma to the neighboring tissues. The fact should never be lost sight of that the anæsthesia induced does not extend, as a rule, very far beyond the operative field; between the anæsthetized area and the neighboring regions a zone of hyperæsthesia seems to exist, on which distant pulls may be painful.

Nerve blocking may be accomplished by four methods, the judicious combination of which meets the purposes of any operation.

1. Blocking the nerve terminals in the immediate vicinity or around the operative area.

2. Blocking the nerves at any point from the spine or skull foramina to the area they supply. The nerves are more accessible in the superficial layers in the immediate vicinity of fixed landmarks. When the anæsthetic solution is injected close to the spine, the method constitutes paravertebral conduction anæsthesia, the Laeven method.

3. Blocking the roots within the spine, but outside the dura mater; called the extradural, epidural or sacral method.

4. Blocking the roots within the dura; known as the intradural or spinal analgesia.

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SOME SURGICAL ASPECTS OF ASPHYXIA*

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THE general subject which I have the honor to discuss, "Analysis of the Blood and Biological Reactions in Surgical Affections," has impressed me as so broad that it has seemed more feasible to choose for presentation only one fundamental biological disturbance. In selecting the sub-title of "Some Surgical Aspects of Asphyxia" it has appeared to me that much might be said of many new facts which are daily being discovered in the laboratories of the fundamental sciences, many of which are of direct practical applicability, and others of which are undoubtedly of potential importance to surgery. The achievements of modern surgery to-day have been made possible chiefly because the surgeon, Lister, recognized the applicability to surgery of the work of the chemist, Pasteur. Future surgical progress will necessarily depend more and more upon the application to the patient of fundamental biological discoveries. The great advances in medicine and surgery will come from those who are so trained in the fundamental sciences that they can recognize the practical application of developments in those sciences to the clinic.

That the disturbance of so fundamental a property of living matter as respiration will lead to serious consequences needs no argument to defend. It will rather be my purpose to call attention to certain ways by which respiration may be disturbed and to some of the consequences which follow any interference with the normal exchange of oxygen and carbon dioxide in the tissues. As a corollary to this point of view, also, some effects of disturbed normal oxidations will be considered as analogous to an asphyxial process, even although they are not associated with a general deficient oxidation in the body. The amount of available knowledge on this question is now so vast that any discussion of this sort will necessarily seem incomplete. I have tried to select chiefly those facts which apparently have a more or less direct applicability to surgery. By the word "respiration" as used in this article I mean not only the act of taking air into the lungs, but cellular respiration as well, the normal interchange of oxygen and carbon dioxide which goes on within all living cells.

PART I

Disturbances of tissue respiration in the human body may occur in any of the following ways:

1. Interference with the intake of oxygen.
2. Interference with the normal power of the blood to carry oxygen, or to remove carbon dioxide.

* Read before the Société Internationale de Chirurgie at the fifth congress at Paris, July 19, 1920.

3. Interference with the circulation of the blood.

4. Interference with the power of the tissues to utilize oxygen.

All of these factors are of interest to the surgeon because he meets with them in his daily experience. In fact, in carrying out a surgical procedure on a single patient he may meet with some phase of all of these factors. A further analysis of them, therefore, will not be inappropriate.

Interference with the Normal Intake of Oxygen.—Interference with the normal intake of oxygen will occur not only with obstruction of the upper air-passages but also in conditions in which there is a reduction of the normal alveolar space of the lungs, and in the breathing of rarefied air. Limitations of time will prevent a thorough consideration of all of these conditions, but certain facts stand out prominently in regard to the reduction of the normal alveolar space of the lungs which are of such peculiar interest and importance to the surgeon that they seem worthy of an extensive discussion. The common causes of this reduction in available breathing area are to be found either in conditions within the lungs, such as œdema and inflammatory exudates, or outside of the lungs, such as abnormal pressures which limit their normal expansion. It is particularly this latter group of conditions which I desire to consider.

It is not without interest that the first "rapport" in the proceedings of this Congress in 1911 was on "Pneumothorax" and that it dealt very largely with a discussion of cumbersome apparatus which had been devised for performing intrathoracic operations with the elimination of the much-dreaded danger of pneumothorax. The war, however, has demonstrated that surprisingly large openings in the thoracic wall are not necessarily followed by death from asphyxia; and the brilliant work of Duval,¹ Grégoire,² Gask and Wilkinson³ and others has shown us that bold operative attack on the lung may be made without recourse to any special apparatus to combat the pneumothorax, and with a degree of success which would have seemed incredible at the time of the last meeting of this Congress. Despite, however, the remarkable operative results which have been obtained, often with an apparently complete neglect of the dangers of an open pneumothorax, nevertheless its inherent danger as a cause of fatal asphyxia in some cases remains, and will continue to remain if steps are not taken to avoid it. It will not be out of place, therefore, to consider the mechanism of action of pneumothorax in some detail; and I believe it has been possible to show that, as a result of recent work, the previous ideas of it are incorrect.

The former, usual conceptions of pneumothorax are based on the assumption that even in the normal chest the mediastinal structures constitute a more or less rigid partition between the two pleural cavities. The general opinion has existed, therefore, that if an open pneumothorax is created on one side, "collapse" of that lung will occur and respiration will be maintained only with the other lung. Evidence of the extent to which this belief is prevalent is seen in the common expressions of "collapsed lung," "sound lung," etc. In the "rapport" on "Pneumo-

thorax" to which reference has already been made Garré stated that, "In open pneumothorax the collapsed lung is functionally completely shut out. With every inspiration the pressure in the two pleural spaces will be different: in the pneumothorax atmospheric pressure, on the sound side a negative pressure (-7 mm. Hg)." The excellent treatises of Emerson,⁵ Sauerbruch,⁶ and L. Mayer⁷ also reflect this same idea of the "collapse" of the lung on the opened side.

As a matter of fact, however, it is possible to obtain evidence experimentally which seems to prove that these conceptions are incorrect. On the contrary, the mediastinum is so mobile in the normal chest that it offers practically no resistance to even slight pressure changes on either side of it. The experiments about to be described were performed in 1918 by Captain R. D. Bell and myself⁸ while members of the Empyema Commission of the United States Army; the details may be found in the original article.

If air is injected into one pleural cavity of a normal human thorax until a pressure of 10 cm. of water is obtained, the pressure in the opposite pleural cavity will register an amount which varies in different individuals from 9 to 9.5 cm. of water. The resistance offered by the mediastinum, therefore, to even so slight a pressure as 10 cm. of water amounts to only 0.5 cm. to 1 cm. of water (0.4 mm. to 0.8 mm. of mercury), which is negligible. These results were obtained on five human cadavers immediately after death, while the bodies were still warm. They are shown graphically in Figs. 1 and 2. Normal dogs, also, which have been killed with ether show identical results immediately after death (Fig. 3). It seems reasonable, therefore, to assume that phenomena observed experimentally on the living dog may be directly applied to the living human.

If an open pneumothorax is created on one side in the normal living dog a characteristic response occurs which is manifested not only by a change of intrapleural pressure on the opened side but also by a change of the same kind, and of practically the same degree, on the unopened side. Briefly, the phenomena which occur are as follows: Immediately after making the opening there is a simultaneous change of pressure in the two pleural cavities from an entirely negative (less than atmospheric) phase to one which oscillates between positive (more than atmospheric) and negative. The size of the opening, as will be shown later, materially influences the extent of the change of pressure. The respirations are sometimes slowed and increased in amplitude, but at other times they are accelerated. As the intrapleural pressure increases, the intratracheal pressure diminishes, as would be expected, since the latter is a rough index of the amount of air passing down the trachea. Immediately upon closure of the opening there is a simultaneous response in both pleural cavities, with a more complete restoration of negative pressure, diminution of the amplitude of the respiratory movements and oscillations again of negative and positive intratracheal pressure on inspiration and expiration (Fig. 4).

A priori it would seem to follow from all this that in the normal chest an open pneumothorax on one side would produce practically an equal amount of compression of both lungs instead of resulting in a collapse of one lung with maintenance of respiration by the other. Again, direct experiment seems to confirm the truth of this conclusion. For determinations of the relative densities of the two lungs after altering the pressure in one pleural cavity show that, within the range of experimental error, the densities are the same and therefore that both lungs are practically equally compressed. The following table shows the relative densities of the lungs of five dogs, in three of which one pleural cavity had been inflated with air to a pressure equal to that of 10 cm. of water:

	Density of lungs	
	Left	Right
No. 1. Right pleural cavity inflated with air to a pressure equal to that of 10 cm. of water	0.74	0.74
No. 2. Left pleural cavity inflated	0.73	0.69
No. 3. Left pleural cavity inflated	0.70	0.72
No. 4. Control, not inflated	0.52	0.48
No. 5. Control, not inflated	0.43	0.51

The extreme mobility of the human mediastinum in the absence of adhesions has been shown in X-ray studies on pneumothorax by Stivelman and Rosenblatt.⁹ Their work tends to confirm the truth of the general idea here being developed of the practical equilibrium of pressure throughout the normal thorax. J. B. Murphy,¹⁰ recognizing the dangerous tendency of the mediastinum to "flutter" in an open pneumothorax, recommended traction on the lung in an attempt to immobilize the mediastinum.

Additional evidence in support of the equality of pressure in the two pleural cavities is obtained when one pleural space of a living dog is injected with a solution of agar. After the agar has solidified by cooling, a cast of the pleural cavity is obtained which allows a direct vision of the relationships which the various intrathoracic structures had to each other during life. Fig. 5 is a photograph of a dog which, while still alive but under ether anæsthesia, received into the right pleural cavity an injection of a solution of agar. The injection was made slowly and was continued until the animal stopped breathing. A long median laparotomy incision was made in order to observe the bulging downwards of the diaphragm. It will be seen in the photograph that, although the injection was made into the right pleural cavity, the left diaphragm bulged downwards and the liver was pushed down on the left side as well as on the right. After death the animal was placed in a refrigerator to allow the agar to solidify by cooling, and later the sternum and a large portion of the anterior thoracic wall were removed. In Fig. 6 it will be observed that both pleural cavities (A and C) are about equal in size. At B is shown the mass of solidified agar which not only occupies most of the right pleural cavity but has also pushed over the mediastinal structures into the left

side of the thorax. The heart (D) almost touched the left lateral wall of the thorax. The right lung was found encased in the agar and lying against the posterior wall instead of being contracted into a small mass about the hilum, as is generally supposed to happen when the lung is compressed. The left lung was also crowded against the posterior wall by the bulging over of the heart and other mediastinal contents. This experiment seems to afford visual confirmation of the idea of the approximate equality of pressures in the two pleural cavities in the dog; and since by previous experiment it had been determined that a freshly killed dog reacts in a manner identical to the human body immediately after death, it seems fair to assume that the conditions found in the dog after the injection of agar are the same as those which would occur in the living normal human.

The older conceptions of the immediate establishment of atmospheric pressure within a pleural space as soon as an open pneumothorax is created fail to take into consideration the fact that the thorax, instead of being a rigid box, has movable walls which, by varying the size of the contained space, also vary the pressure within it. If the older conceptions were correct, then a small opening into the chest would have the same consequences as a large one because in each case "collapse" of the corresponding lung would occur. It would follow from this also that in a normal chest a unilateral open pneumothorax ought never to be fatal regardless of how large the opening might be, since the worst possible consequence would be the "collapse" of one lung. Similarly, also, with the same line of reasoning, a bilateral open pneumothorax should always be promptly fatal. Experiences, however, both experimental and in the war, which controvert these two conclusions, have been many. It is also easy experimentally to demonstrate that there is a definitely quantitative relationship which exists, in any individual with a normal thorax, between the size of the opening in an open pneumothorax and the danger of death, because the really important factor is the amount of air which enters the chest from the outside with each inspiration.

A mathematical expression has been devised by which it is possible to approximate in a given case the maximum opening in the chest wall which is compatible with life. This expression is as follows:

$$X \equiv \frac{V - \frac{R_1}{R_2} T}{\frac{R_1}{R_2} T} aC$$

in which V is the vital capacity,
 R_1 is the rate of respiration before the opening is made,
 R_2 is the rate of respiration after the opening is made,
 T is the tidal air (approximately 500 c.c.),
 a is a factor less than 1 (assumed to be about 0.8),
 C is the area of the glottis (about 2.25 sq. cm.).

By substituting numerical values the determination of X becomes a problem of simple arithmetic. The average vital capacity V and the tidal air T are given by Howell¹¹ as 3700 c.c. and 500 c.c., respectively. The normal rate of respiration R_1 during complete rest is about 15 per minute and the maximum rate R_2 for the greatest possible depth of respiration is about 60 per minute.

$$\frac{R_1}{R_2} T \text{ then equals } 125 \text{ and}$$

$$X = \frac{3700 - 125}{125} \text{ aC} = 28.6 \text{ aC}$$

$$X = 28.6 (0.8 \times 2.25) = 51.5 \text{ sq. cm.}$$

In other words, in an individual with an average "vital capacity" (3700 c.c.) an opening of about 51.5 sq. cm. (8.1 sq. inches) is the largest for which compensation can be made if the mediastinum has a normal mobility. It is obvious, however, that when the factor V ("vital capacity") is increased the value of X will also increase. Consequently those individuals whose "vital capacities" are greater than 3700 c.c. will be able to withstand openings of greater areas than 51.5 sq. cm. In this connection it is noteworthy that Peabody and Wentworth have shown that the average vital capacity for men is considerably higher than that of the general average of both men and women. The average value based on their observations on men is 4633 c.c. If we substitute this value for V in our equation we find a value for X of 64.8 sq. cm. (10 sq. inches). The maximum opening, therefore, for which the average man can compensate is about 64.8 sq. cm. In the exceptionally large man of athletic build, as, for example, in the case of the man mentioned by Peabody and Wentworth,¹² who had a "vital capacity" of 7180 c.c., a relatively enormous opening in the chest wall can be compensated for. In such a case, for instance, the value of X in our equation would be 101.3 sq. cm., or 15.6 sq. inches. Practically, the opening must be somewhat smaller, since the extra work performed by the muscles of respiration to establish compensation increases the amount of air required. The presence of toxæmia, infection or any other cause which increases the level of metabolism will decrease the safety limits of the maximum size of the opening, as will also any condition reducing the available breathing space of the lung. The use of general anæsthesia will probably also act in the same way. It should be borne in mind that the value of X represents the approximate maximum opening compatible with life only so long as the respiratory muscles can maintain a maximum respiratory movement, and in addition, that it is only an approximation because of the variability in different individuals of some of the other factors, as, for example, C . It is striking, however, that, owing to the negligible resistance offered by the mediastinum, it makes very little difference whether there is a unilateral or a bilateral open pneumothorax, provided that the combined areas of the openings in the bilateral case do not exceed the area of the unilateral

opening. This fact clearly controverts the former conception of the necessary "collapse" of a lung after the creation of a pneumothorax. In fact, if in a living dog an opening into the chest be made in a suitable place for inspection, as, for example, in about the fifth interspace in the mid-axillary line, the expansion and contraction of the lung can be observed to occur with each act of respiration.

The reasons for this quantitative relationship are to be found in the facts that: (1) it is possible to maintain life as long as the lungs can inspire the "tidal air," which normally is from 300 c.c. to 500 c.c.; (2) a considerable encroachment on the volume of the two lungs can be made before a stage is reached at which it is no longer possible for the lungs to obtain the "tidal air," and (3) in the compensatory reaction, by an increase in the amplitude of the respiratory movements the thorax is enlarged so that actually more air may enter through the pneumothorax opening without encroaching on the "tidal air" to the same extent than would be the case if the thorax were not enlarged.

It must be particularly emphasized, however, that this consideration of the practically negligible resistance of the mediastinum, with the associated equality of pressure throughout the thorax, refers only to the normal thorax. Obviously, a thickening of the mediastinum by old inflammation and the presence of strong adhesions will change the conditions and will permit the development of a considerably greater pressure on one side than on the other.

In addition to its effects on respiration, an open pneumothorax also induces other harmful effects. These have been summarized by Sauerbruch as loss of heat, danger of infection and disturbances of the circulation. He has made the important observation that the loss of heat from an open pneumothorax may exceed that which follows an extensive laparotomy incision with eventration of the intestine. Also, owing to the changed pressure relationships, a stasis in the venous system occurs which is shown by an actual increase of pressure in the femoral vein.

In the case of a closed pneumothorax very different conditions from those in an open pneumothorax are present. In the description of the characteristic changes produced by making a free opening into the pleural cavity it was stated that the closure of the opening resulted in a sudden restoration of negative pleural pressure and a prompt relief from dyspnoea. Obviously, after making the closure, air is still retained in the pleural cavity, so that the very striking difference in the phenomena observed must be due merely to the fact that an open pneumothorax has been converted into a closed one. Although air is absorbed from the pleural cavity, it disappears only slowly; and the sudden benefit noted by the closure of the opening cannot be attributed to the immediate disappearance of the air. Apparently the explanation of the relative harmlessness of a closed, in comparison with an open, pneumothorax lies rather in the fact that the ability to compensate for interference with the aëration of

the lungs is limited. In a closed pneumothorax, no matter how much air is contained in a pleural cavity, no additional air can enter. It is necessary, therefore, only for the animal to increase his respiratory effort sufficiently to create enough negative pressure to allow him to take in the requisite amount of air to maintain oxygenation of his blood. Under conditions of rest this amount is equivalent only to the "tidal air," which in the human is only a relatively small fraction of the "vital capacity" (from about one-seventh to one-twelfth). Accordingly, therefore, a fatal asphyxia should not occur until so large a proportion of the lung capacity has been replaced by air in the pleural cavity that his "vital capacity" equals his "tidal air," provided that the animal is at rest, that his ability to compensate by increasing his respiratory effort is good and that there is no extra abnormal demand for air such as might arise from toxæmia. When an open pneumothorax is converted into a closed one, particularly if the closure is made at the end of expiration, the amount of air enclosed in the pleural cavity is very much less than the normal difference between the "tidal air" and "vital capacity," and naturally, therefore, there is comparatively little dyspnoea. On the other hand, in the case of an open pneumothorax there is an active competition for air going on between the trachea and the pleural opening. At each inspiration air not only enters the trachea but also enters the pleural cavity, and if the diameter of the pleural opening is the same as that of the glottis, practically the same amount of air will enter the pleural cavity as will enter the lungs, and the animal will be compelled to increase his respiratory effort to get the "tidal air" into his lungs. If the opening is considerably larger than the glottis it will be still more difficult to get the required amount of air into the lungs. When it is so large that more air than the difference between the "tidal air" and the original "vital capacity" enters the pleural cavity with each inspiration, the animal will no longer be able to obtain the requisite "tidal air" and death from asphyxia will occur. This theoretical discussion is, of course, only an approximation and is not strictly accurate, since it is necessary to consider the actual amount of air entering by each opening rather than merely the difference in area, a consideration which involves also the relative lengths of the pleural opening and the trachea with the resultant friction to the passage of the air. Observations, however, both clinical and experimental, tend to confirm the truth of this explanation. Clinically, it is well known that an individual of average size may have no alarming dyspnoea from a pleural exudate amounting to 2000 c.c. or 2500 c.c. Exudates greater than this, however, frequently produce very severe dyspnoea, particularly if the respiratory muscles are weak. Experimentally we have injected into the pleural cavity of a dog of 8 kilos, through a small needle, as much as 1800 c.c. of air over an interval of twenty minutes without producing any marked asphyxia. Beyond that point, however, additional injections of only 50

c.c. at a time each had a very noticeable effect in increasing the dyspnoea, and the animal died after about 2100 c.c. of air had been injected.

The applications of these newer conceptions of the physiology of pneumothorax are very extensive, but they have a particular bearing upon the questions of both the treatment of empyema and the handling of wounds of the thorax.

During the winter of 1917-1918 the military camps in the United States were ravaged by a very severe epidemic of respiratory infections associated with a hæmolytic streptococcus. A very extensive bronchopneumonia and a high incidence of empyema were conspicuous features of this epidemic. Clinically, during the acute stage of the illness, an extreme grade of cyanosis, dyspnoea and air-hunger were common; and at autopsy, as was well shown by MacCallum,¹³ a ready explanation was found in the fact that many of the bronchioles were completely occluded both by contained exudate and by cedema and induration of their walls, so that often there existed an actual impediment to the passage of air into alveoli which were not themselves already filled with exudate. Early in the course of the disease there occurred a pleuritis accompanied by a massive fluid exudate which contained myriads of hæmolytic streptococci. In the early stages this exudate was only slightly purulent but was rather markedly hemorrhagic. Later it became more and more purulent, so that usually at the expiration of about ten days or two weeks it was frankly purulent.

In general the method of treatment that was at first employed was the conventional one of the establishment of open drainage, either by a simple thoracotomy or a rib resection, as soon as the diagnosis was made of the presence of fluid containing streptococci. Alarming reports of the high mortality of these cases led to the appointment, by the Surgeon General, of an Empyema Commission¹⁴ for the purpose of making a thorough investigation of the question. My good fortune in being made a member of this Commission afforded me the opportunity of observing an unusually large number of cases of empyema. The average mortality based on replies from all the camps in February, 1918, was 30.2 per cent., but in some of the camps it reached the appalling figure of from 70 to 95 per cent. Realizing that any further embarrassment to respiration might be fatal in those who were already having difficulty to obtain enough air to support life, the Commission instituted at Camp Lee, Virginia, a change in the plan of treatment. Instead of inducing early drainage, aspirations with a Potain aspirator were performed as often as necessary, with the idea of delaying operation until the active pneumonia had subsided. Following this procedure there was an immediate drop in mortality to 4.3 per cent., and in 13 per cent. of our cases aspiration alone proved sufficient, so that it never became necessary to establish drainage. At other camps, also, where independently the principle of the avoidance of an open pneumothorax in the early stage of the disease was instituted, a marked fall in the mortality occurred. Stone¹⁵ has shown the drop in

mortality which occurred at Fort Riley, Kansas, after substituting aspiration for operation during the early acute stage. His cases are divided into three series, and the following quotation from his article will reveal the striking difference in mortality:

"1. First series: Early operation (October 20, 1917, to January 21, 1918), 85 cases. Mortality, 61.2 per cent.

"2. Second series: Early aspirations and late operation (January 12, 1918, to August 10, 1918), 96 cases. Mortality, 15.6 per cent.

"3. Third series: Early aspirations and late operation (October 18, 1918, to February 14, 1919), 94 cases. Mortality, 9.5 per cent."

It is possible that one factor in the remarkable reduction of mortality in these cases was a diminished virulence of the organism. On the contrary, however, as a result of the experience with the epidemic in the army, there exists now in the United States an almost unanimous feeling that the creation of an open pneumothorax during the acute pneumonic stage of an empyema should be scrupulously avoided. The experimental findings discussed above seem to afford a rational explanation of the danger inherent in the establishment of open drainage at too early a period, and they are particularly applicable to streptococcus cases. When it is recalled that in these cases the type of pneumonia is such that many of the bronchioles are occluded, it occasions no surprise that a high grade of cyanosis and dyspnoea exists. This situation in turn will lead inevitably to a marked reduction of the "vital capacity." The result of any considerable reduction of the "vital capacity" will in turn diminish the size of the opening which can be made in the chest wall without producing a fatal asphyxia, and if the "vital capacity" becomes so low that it equals the "tidal air," then it will be impossible to compensate for an opening of any size. If, however, an opening is not made until later, after the active pneumonia has subsided, then very different conditions are encountered. In the first place, the subsidence of the pneumonia has opened up the occluded bronchioles so that the patient is no longer suffering from air-hunger. His "vital capacity" is, therefore, considerably increased. Moreover, adhesions have formed so that actually the opening is not made into a free pleural cavity, but into a circumscribed abscess. The dangers of an open pneumothorax at this time have consequently been reduced to a minimum. The more favorable mortality figures in cases of pneumococcus empyema are perhaps due, in a large measure, to the fact that the condition is generally not recognized and therefore not operated upon until after the pneumonia has subsided. The older conceptions of pneumothorax will not adequately explain the harmful effects of open drainage during the early, pneumonic stage of an empyema. For, according to such conceptions, the worst that could happen would be the collapse of the lung on the affected side; and furthermore, a large opening would have slightly, if any, greater consequences than a small one.

Another application of the experimental results concerns the question

of wounds of the thorax. Reference has already been made to the experience of all army surgeons that surprisingly large gaping wounds of the thoracic wall did not necessarily result in a fatal asphyxia. This finding is easily explained, however, by the quantitative relationship between the size of the opening, the "vital capacity," and the other factors mentioned above in this connection. For it has been shown, on the basis of our calculations, that an average normal man, even without adhesions, can compensate for an opening of about 64.8 square centimetres (10 square inches) until his respiratory muscles become fatigued or unless his need of oxygen becomes abnormally great. Practically, in operative procedures on the chest, measures are always adopted by the operator to reduce the size of the opening. One which is apparently very large is often actually much smaller, because of the presence in the incision of a lung which has been delivered out, gauze sponges, instruments, and fingers of the operator or of his assistants, all of which by their plugging tend to reduce the area of the opening. Also, the delivery of the lung outside of the chest wall accomplishes to some extent the immobilization of the mediastinum. There is, therefore, apparently a perfect harmony between the conceptions of pneumothorax based on the above experimental results and the clinical observations on wounds of the thorax.

Interference with the Power of the Blood to Carry Oxygen or to Remove Carbon Dioxide from the Tissues.—Disturbances in the power of the blood to carry oxygen include all those conditions in which the hæmoglobin is either reduced in amount or so changed in form that the normal amount of oxyhæmoglobin is not present. Such a condition is, of course, always encountered in connection with a severe anæmia, whether acute or chronic. The marked signs of asphyxia, such as air-hunger, etc., which occur after a severe hemorrhage, are too well known to every surgeon to require comment. The asphyxial effects on the tissues of a severe chronic anæmia are likewise important, although less conspicuous clinically than those of a severe hemorrhage. These effects will be considered in more detail in Part II.

Of less importance to the surgeon are the changes which occur in the hæmoglobin itself which diminish the amount of oxyhæmoglobin. Since the tissues receive practically all of their oxygen because of the instability of the oxyhæmoglobin combination, whereby oxygen is easily split off, it becomes apparent that any other hæmoglobin combinations which would prevent, on one hand, the union with, or, on the other hand, the dissociation off of oxygen from the hæmoglobin would have practically the same effects on the individual as the loss of an equivalent amount of blood. A striking example of such a condition is found in cases of poisoning with carbon monoxide. The combination which this gas forms with hæmoglobin is a relatively stable one which prevents the union of oxygen with hæmoglobin. Poisoning with this gas therefore produces a severe general asphyxia. Other hæmoglobin combinations, also, have been described,

such as methæmoglobin, which is found especially in pneumonia, and hydrogen sulphide hæmoglobin, etc., which in varying degrees produce asphyxial effects by interference with the normal amount of hæmoglobin available for combination with oxygen.

The question of the disturbances of the power of the blood to remove carbon dioxide from the tissues is of vital importance in connection with the phenomenon of "acidosis" which will be discussed in more detail in Part II.

Interference with the Circulation of the Blood.—Any condition which disturbs the normal transport of oxygen from the lungs to the tissues will also, to a more or less degree, result in asphyxial effects. Such a condition is encountered locally whenever an important vessel (either artery or vein) is occluded or destroyed. As will be seen later in Part II, a considerable difference in the results will occur, depending on the degree of the local asphyxia, its duration, and the availability of fluids to the affected tissues. Disturbances of the circulation which are accompanied by general asphyxial effects are found particularly in uncompensated heart disease, in shock, and in pneumothorax. The very excellent work on shock of Crile,¹⁶ Seelig and Joseph,¹⁷ Cannon,¹⁸ Mann,¹⁹ and of Erlanger²⁰ and his coworkers, in the United States, of Bayliss²¹ and others in Great Britain, and of Quénu and others²² in France has shown beyond a doubt that the factor of asphyxia from a disturbed circulation is of the greatest importance.

Interference with the Power of the Tissues to Utilize Oxygen.—Since the ultimate acts of respiration consist in the utilization of oxygen by the cells and the giving off of carbon dioxide, it becomes evident that, theoretically at least, conditions might arise which would disturb the normal power of the tissues to utilize oxygen even when available. Such disturbances, of course, if of sufficient degree, would result in a fatal asphyxia as surely as an obstruction of the trachea. For many years a large amount of evidence has been accumulating that the state of narcosis or surgical anæsthesia is associated with a definite diminution of tissue respiration. This has been shown particularly in the work of Verworn,²³ Mansfeld,²⁴ Mathews,²⁵ Tashiro,²⁶ and Jacques Loeb.²⁷ This reduction in tissue respiration is independent of any important disturbance with the intake of oxygen, of the oxygen-carrying power of the blood, or of the circulation of the blood. Its explanation, therefore, must lie in the inability of the cells to utilize oxygen even when it is available. The opinion is now, in fact, general that narcotic drugs as a class interfere with the power of the cells to utilize oxygen. This opinion is based chiefly on work which has been done with the common anæsthetic agents, for example, chloroform, ether, alcohol and nitrous oxide, but it doubtless is true as regards all of the narcotic drugs. The cyanides also probably owe their action chiefly to this effect. Acids interfere seriously with tissue respiration, and the effects which they induce are practically identical with those which fol-

low a severe asphyxia. The idea, originally advanced by Verworn, that narcosis is synonymous with asphyxia, has been found, however, by Loeb and Wasteneys²⁸ to be incorrect.

In diabetes mellitus there is an inability on the part of the tissues to utilize oxygen for the combustion of sugar notwithstanding the fact that there is no demonstrable deficiency of general oxidations. As a result, however, some of the conspicuous features of asphyxia are present in this disease. Likewise, in poisoning with phosphorus the characteristic lesions are practically identical with those of asphyxia, although Lusk³² has shown that there is no general decrease of oxidations.

PART II

EFFECTS OF ASPHYXIA

The effects of interference with the normal processes of oxidation are necessarily numerous, as might be inferred from the disturbance of so fundamental a property of living matter as respiration. Some of these effects are so pronounced that visible pathological changes are induced; others are concerned more with physiological disturbances which require chemical methods for their detection.

It is, of course, a very old observation that any measure which completely shuts off the supply of oxygen to a part for a long enough time results in its necrosis. It is also well known that there is a tendency for such a part to imbibe water and to swell, if water is available. But a similar swelling or œdema is frequently observed when the oxygen supply is only partially reduced, or if completely shut off for only a short period. It therefore becomes apparent that the amount of œdema is largely dependent upon the degree to which the circulation fails to remove the products of metabolism, the oxygen deprivation and the amount of available water. It is easy to understand also that at least a transient œdema will follow the occlusion of an important artery (for example, the femoral), but that it will be less in degree than that which follows the occlusion of the corresponding vein, because in the latter case more water is made available for the swelling of the cells. In 1898 Jacques Loeb²⁹ brought œdema into relationship with a deficient supply of oxygen and the incidental formation of acid. Martin Fischer³⁰ has more recently emphasized the importance of the action of the asphyxial acids on the tissue colloids. The extensive controversy which Fischer's work has aroused, particularly in the United States, I shall avoid discussing.

Other morphological effects of disturbed oxidations are fatty "degenerative" changes and a tendency to the production of hemorrhages. For many years the presence of excessive amounts of fat in the liver in conditions of impaired oxidation was ascribed to a degenerative process by which the cell contents were actually transformed into fat. The work of Rosenfeld,³¹ however, showed conclusively that, at least in the case of phosphorus poisoning, most of the abnormal fat is transported from the

various fat depots in the subcutaneous tissues, the omentum, etc., and that therefore it does not represent a transformation of the cellular tissues into fat. Graham Lusk³² has drawn a definite relationship of these abnormal infiltrations of fat to asphyxial conditions by showing that they occur whenever there is an inability on the part of the cell to oxidize sugar, and that consequently in reality they represent a condition of "sugar hunger" in the cell. It is not surprising, therefore, that in severe diabetes, in which there is practically a total inability on the part of the body to oxidize sugar, a marked fatty infiltration of the viscera should be found, provided that there is not a sufficient degree of emaciation as to preclude a transportation of fat from the various fat depots of the body to the liver and other viscera. An excessive fat infiltration of the liver can be readily produced in the dog by methods which induce an experimental diabetes, as, for example, by the injection of phlorizin or by removal of the pancreas. Likewise any condition associated with a general lack of oxygen, as has been shown by Araki,³³ Bauer,³⁴ and by Martin, Loevenhart and Bunting,³⁵ and others, will lead to an accumulation of fat in the liver and elsewhere. The evidence, therefore, seems incontrovertible that abnormal infiltration of fat is an expression of impaired oxidation.

Every severe asphyxial condition is accompanied by the production of hemorrhages. These may be localized if the asphyxia is local, as, for example, in hemorrhagic infarcts, or they may be more or less generalized if the asphyxia is general, as in obstruction of the trachea if death does not occur too suddenly. The explanation of these hemorrhages is not simple, and doubtless many factors are involved. It would seem not unlikely, however, that a fundamental and widespread change occurs as a result of which not only fibrinogen but many other proteins tend to remain in solution or to pass into solution, with the result that apart from diminished blood coagulability there is a great reduction in the firmness of the vessel walls. Some light has been thrown on this question in the very excellent series of articles by Nolf³⁶ and by Doyon³⁶ and his coworkers. These investigators have produced a considerable amount of evidence which indicates that fibrinogen is formed mainly in the liver. It follows logically from this fact, therefore, that any condition in which the function of the liver is seriously impaired may be accompanied by a tendency to the production of hemorrhages. Since the liver is one of the organs in which oxidations are most active, it is not surprising that asphyxial conditions affect it particularly and that hemorrhages are practically a constant accompaniment of a general asphyxia.

We may recognize, therefore, a definite syndrome of gross pathological changes which are induced by either a deprivation of oxygen or by impaired oxidations, although it is probable that a failure to remove the waste products of metabolism is often an important auxiliary factor in its production, especially in conditions of disturbed circulation. This syndrome consists of œdema, fat infiltration, a hemorrhagic tendency,

and necrosis. All tissues do not show these changes to the same degree even when subjected to approximately the same amount of oxygen deprivation or of disturbance of circulation. Fat infiltration, for example, is more conspicuous in the liver than in any other organ. Furthermore, although this syndrome is induced by asphyxial conditions, it is not certain that the converse is true and that it can always be considered that asphyxial conditions are present when this syndrome occurs; for, as is well known, it may be found in many severe infections and in intoxications of many kinds both with known and unknown agents. The similarity of pathological effects, however, as well as other changes which are not accompanied by visible lesions suggests that in all such cases there is a disturbance of normal cellular respiration. The group of conditions referred to comprises not only the infections with the common bacteria, but also those diseases known as acute yellow atrophy of the liver, eclampsia, etc.

Another effect of oxygen deprivation or of disturbed oxidations is the phenomenon of so-called acidosis. Originally used with reference to the abnormal accumulation and excretion of certain organic acids in diabetes, the term has more recently been given a much broader application, so that it now is used in reference to a large variety of conditions. If the normal oxidation of sugar and of fat is disturbed various organic acids and acetone may appear in the blood and urine because of a failure to oxidize them completely to CO_2 . These acids, such as β -oxybutyric, aceto-acetic, etc., together with the acetone, represent stages in the incomplete oxidation of fat and perhaps of certain amino-acids. They may appear, therefore, not only in conditions of a general deprivation of oxygen, but also where there is a selective impairment of sugar oxidation, as in diabetes. Simultaneously also with the appearance of these substances in the urine abnormal amounts of ammonia are found, a fact which is interpreted as an expression of a mechanism to neutralize the abnormal acids. The more recent uses of the term acidosis, however, are in reference to any disturbance of the normal reserve alkalinity of the blood, whereby it becomes less able to "take up" acid than is normal blood.

As has been shown by L. J. Henderson³⁷ the reaction of the blood under normal conditions is perhaps the most constant phenomenon of any occurring in the body. The constancy of this reaction is maintained chiefly in four ways: (1) the excretion of CO_2 by the lungs, (2) the excretion of acid by the urine, (3) the neutralization of acids by ammonia formed chiefly in the metabolism of proteids, and (4) the combination of acids with proteids. The common conception is that the CO_2 combines with the carbonates of the blood to form bicarbonates and is carried to the lungs where it is exhaled. The normal excretory power of the kidneys is also very essential; for it is by this route that the body eliminates much acid. It is apparent, therefore, that the clinical expressions of acidosis are often intimately associated with impaired kidney function.

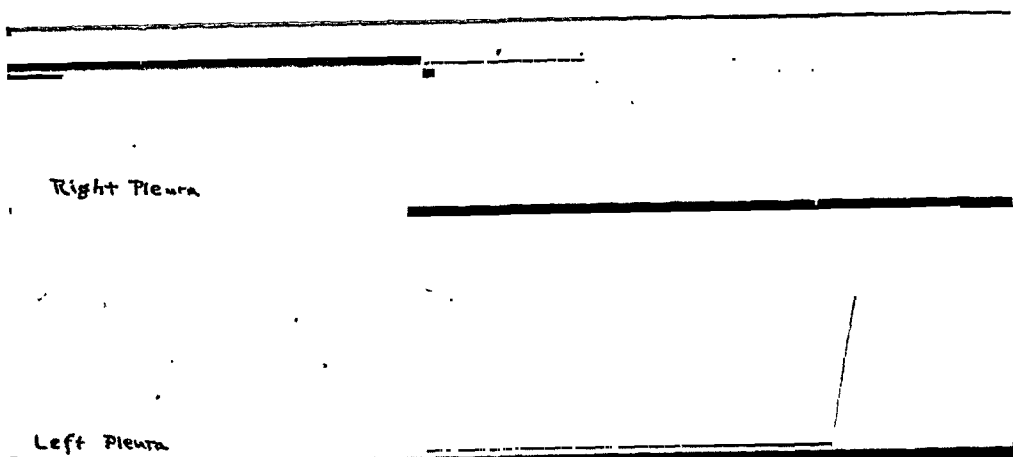


FIG. 1.—Tracing showing that when the left pleural cavity of a fresh adult human cadaver is inflated with air at a pressure of 10 cm. of water the right pleural cavity registers a pressure of 9 cm. The top line is a record of a pressure of 10 cm. made with the tambour attached to the right pleural cavity. Calibration showed that the actual pressure was 9 cm. of water.

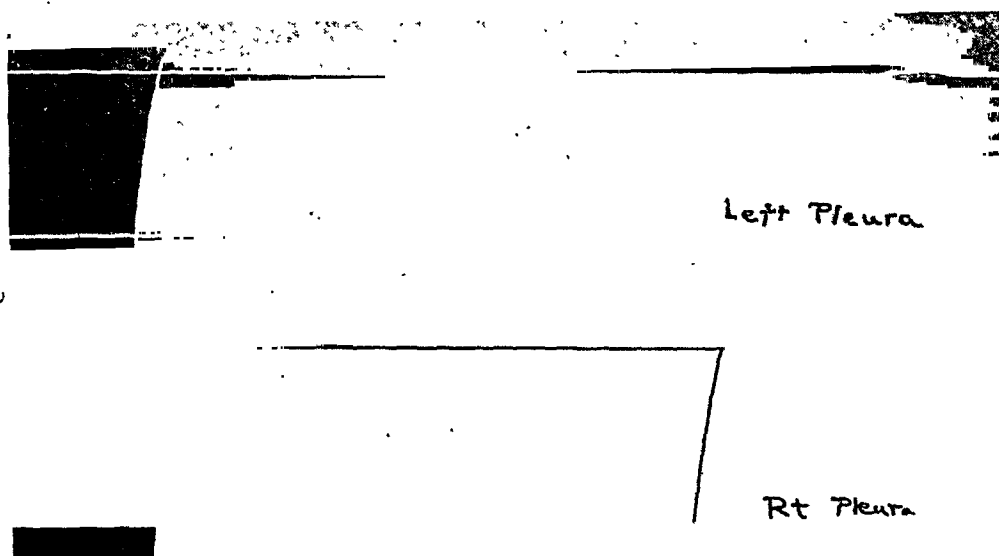


FIG. 2.—A similar tracing with the right pleural cavity inflated. Calibration showed that in this case also there was a difference in pressure of only 1 cm. of water (about 0.8 mm. of mercury).

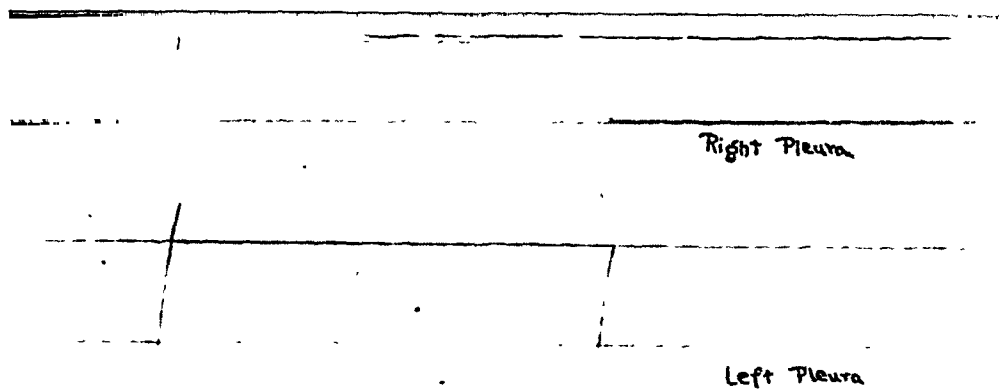


FIG. 3.—Tracing made in the same way with a recently killed dog which shows that the dog is strictly comparable with the human, since here also the difference in pressure between the two pleural cavities amounted to only 1 cm. of water.

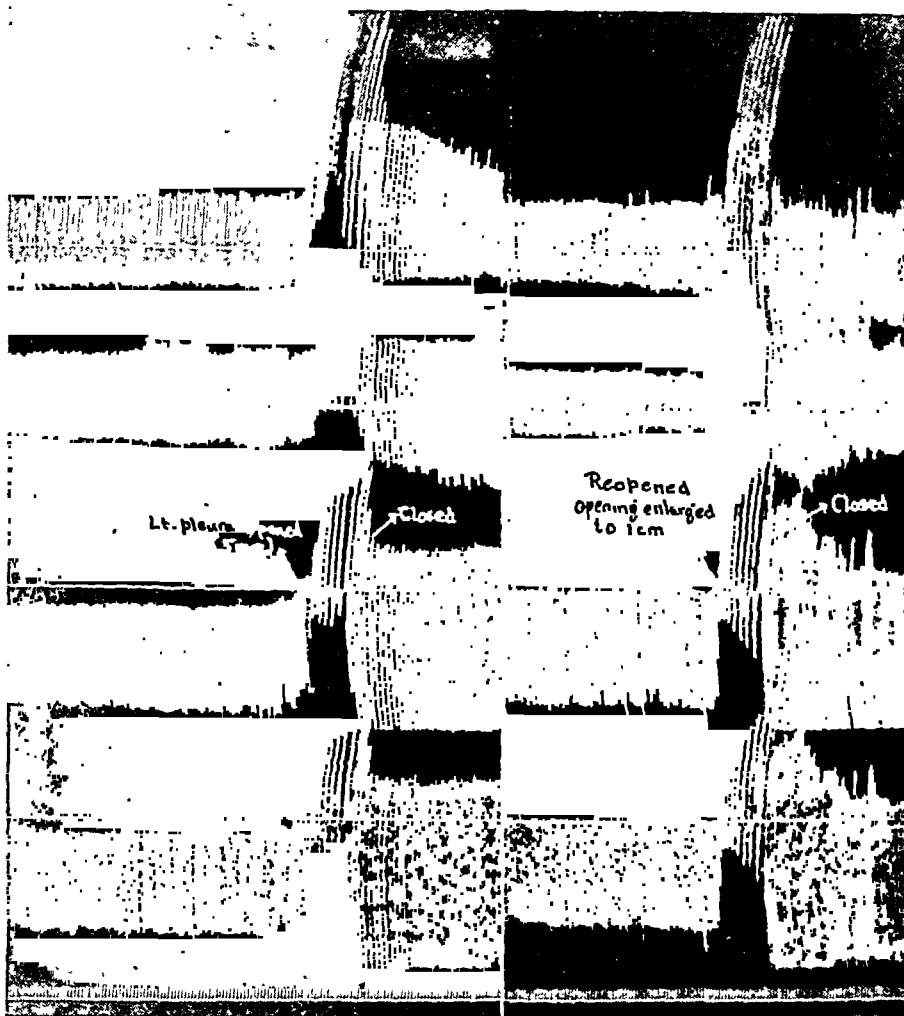


FIG. 4.—A tracing made on the living dog under ether anaesthesia to show the nature of the reaction to an open pneumothorax with a moderate opening, as indicated in the changes in the respiratory movements, in the tracheal pressure and in the pressures in both pleural cavities. The upper tracing represents the respiratory movements, the next the tracheal pressure, the third the left pleural pressure and the fourth one the right pleural pressure. The lowest line indicates the time in seconds. The base lines were drawn at atmospheric pressure. The break in the chart represents an interval of six minutes. Immediately after making the opening there is a simultaneous change of pressure in the pleural cavities from an entirely negative phase to one which is mostly positive. The respirations are slowed but are increased in amplitude. If the experiment is performed with local anaesthesia, however, the respirations are accelerated as well as being increased in amplitude, after making the opening. Because the intrapleural pressure is largely positive, practically no air enters the trachea and the intratracheal pressure tends to be at equilibrium with atmospheric pressure. Immediately upon closure of the opening there is a simultaneous response in both pleural cavities, with restoration of negative pressure to a large extent, diminution of the amplitude of the respiratory movements and oscillations again of positive and negative intratracheal pressure, with inspiration and expiration. After an interval of six minutes, during which time probably most of the air in the pleural cavities has been absorbed, the intrapleural pressure has again become entirely negative.



FIG. 5.—Photograph of a dog which had been injected into right pleural cavity with a solution of agar while alive but under ether anæsthesia. The agar solution was run in slowly until the animal died. The abdomen was opened, before beginning the experiment, by a median laparotomy incision to show the bulging downwards of the diaphragm with the associated pushing downwards of the liver. It will be noted that, although the agar solution was introduced into the right pleural cavity, the left diaphragm bulges downwards and the liver is pushed down on the left side as well as on the right.



FIG. 6.—Same dog as shown in Fig. 5. Immediately after death it was placed in a refrigerator for three hours to allow the agar to solidify, and the chest wall was then opened as shown in the photograph. A represents the right pleural cavity, which was found to be of practically the same size as the left pleural cavity C. At B is shown the mass of solidified agar which occupied most of not only the right pleural cavity but also pushed the mediastinal structures over into the left side of the thorax. At D is the heart which nearly touched the left lateral wall of the thorax. E shows the liver. The right lung was found encased in the agar and lying against the posterior wall instead of being contracted into a small mass about the hilum, as is generally supposed to happen when the lung is compressed. The left lung was also crowded against the posterior wall by the bulging over of the heart and other mediastinal contents. This experiment affords striking confirmation of the idea of practically an equality of pressure throughout the normal thorax at all times.

It is for this reason that, as will be shown later, it is desirable often to examine a patient not only for an acidosis but also for conditions of associated diminished kidney excretion.

Other effects of asphyxia will be mentioned briefly, such as changes in the nature of the act of respiration, the effects on muscles, and the occurrence of glycosuria. In cases of acidosis the pulmonary ventilation is increased by a greater amplitude and also by a greater rate, constituting sometimes even a condition of "air-hunger." All the evidence seems to indicate that this change in the type of respiration is due to the influence on the respiratory centre of CO_2 and other acids and their resulting minute effect on the hydrogen-ion concentration of the blood rather than to a lack of oxygen.

The response of the muscles to the effects of asphyxia is of special interest to surgeons. Contractions usually occur which are often very violent. This phenomenon is seen in a striking manner in cases of severe strangulation, in which there are general convulsions of the opisthotonus type. The unstriated muscles also react in a similar way, as shown by the excessive peristalsis and the strong uterine contractions which often accompany a state of general or local asphyxia. They are seen to a less marked degree in the twitchings and tremors of the extremities during an incomplete or poorly conducted anæsthesia. These phenomena were studied experimentally by the author³⁸ several years ago and were made the basis of a suggestion of the origin and nature of fetal movements. The effects on the blood-vessels are also important and are of two kinds, depending upon whether the vasomotor centre in the medulla and the spinal centres are involved, or whether the asphyxial process is confined more locally. In the former case the response is a general vasoconstriction with a resulting rise in blood-pressure which will gradually drop as the severe state of asphyxia persists. All the evidence is in favor of the idea that this phenomenon is the result of the action of CO_2 and other acid substances rather than merely to a lack of oxygen. In the second case, in which the asphyxial process is confined to a local region without an associated effect on the vasomotor centres, the usual response is a marked dilatation of the blood-vessels. By this means the blood-flow through the part is greatly increased. Here again the evidence strongly indicates that acid substances in the part (CO_2 and lactic acid) are important agents in the production of the phenomenon. The evidence for this view is based largely on the work of Gaskell and Langley,³⁹ Bayliss,⁴⁰ Schwarz and Lemberger,⁴¹ Ishikawa,⁴² Starling,⁴³ and Hooker.⁴⁴ Recently Woolley⁴⁵ has sought to correlate these facts to the vascular dilatation which occurs in inflammation.

The occurrence of glycosuria in asphyxial conditions is an old observation, apparently having been made originally by Richardson⁴⁶ in 1862 in experimental carbon monoxide poisoning. It was largely Araki,³³ however, who showed that glycosuria may be present in any condition in

which there is a diminution in the supply of oxygen to the tissues. It occasions no surprise, therefore, that frequently after a prolonged anæsthesia there is a transient glycosuria.

Application of a Knowledge of the Effects of Asphyxia to Clinical Conditions.—There are very many surgical conditions in which the effects of asphyxia are conspicuous. I shall discuss only a few in which they are especially prominent. As has been mentioned above, the general narcotic agents belong to a group of substances the effect of which is to diminish oxidations in the tissues and thereby to induce a condition of asphyxia. It is important that some detailed consideration be given to this point. Of the agents most commonly employed to produce general surgical anæsthesia or narcosis, all the evidence at hand shows conclusively that chloroform is the most powerful in causing asphyxial effects and that nitrous oxide is the least harmful in this respect. Ether occupies an intermediate position. This knowledge has led to an almost complete abandonment in America of chloroform as an anæsthetic agent and the substitution for it of ether or nitrous oxide. The use of the latter has been popularized very largely by the work of Crile. Woodyatt and Sansum⁴⁷ have shown in a very striking manner that in dogs made completely diabetic by phlorizin it is almost impossible to produce narcosis by chloroform without death but that the tolerance for ether is very much greater than for chloroform and that a narcosis with nitrous oxide can be maintained for a period of hours without death even in such animals. One of the most striking features about chloroform is that its toxic effects may not culminate in death until two or three days after its administration, at which time almost all of the cardinal features of a severe asphyxia may be present. For example, the pathological syndrome, of which we have already spoken, of œdema, fat infiltration, hemorrhages and necrosis are conspicuous, and in addition other features such as an acidosis, the occurrence of acetone and products of deficient oxidation in the urine, etc. One of the first to call attention to this condition was Guthrie⁴⁸ in England in 1894. Since that time many notable contributions have been made. For a full discussion of the literature the reader is referred to the articles by Bevan and Favill,⁴⁹ Wells,⁵⁰ Whipple and Sperry,⁵¹ and Howland and Richards.⁵²

Having become interested in the question of why chloroform should be more toxic than the other anæsthetic substances, the writer in 1915⁵³ published some observations based on experimental work which indicated very strongly that chloroform is decomposed in the body in such a way as to yield hydrochloric acid. This property of decomposing to yield the corresponding halogen acid is shown not only by chloroform but it appears to be a general characteristic of that group of substances which is known chemically as the alkyl halides. This group includes such substances as iodoform, ethyl chloride, ethyl bromide, ethyl iodide, etc. Each of these is decomposed in the body with the liberation of its corresponding

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halogen acid, hydrochloric, hydrobromic or hydriodic, as the case may be. On the other hand, ether and nitrous oxide are incapable of yielding a strong mineral acid in their breakdowns within the body. These facts offer a ready explanation of the increased toxicity of chloroform over these latter substances, and they show at once the great danger to which a patient is always subjected when given chloroform. This danger is correspondingly increased if he is already suffering from an acidosis or from any other effects of an impaired tissue respiration. Chloroform is, therefore, particularly interdicted in severe acute infections, in diabetes, in conditions of impaired kidney function, in thoracic surgery in general, in conditions of starvation with acidosis, etc. From the standpoint of minimizing the effects of disturbed tissue respiration, the evidence is overwhelming that the safest general anæsthetic agent is nitrous oxide when combined with oxygen and when given by a skilled anæsthetist. Ether occupies an intermediate position between nitrous oxide and chloroform.

Other surgical conditions in which the effects of disturbed tissue respiration are conspicuous are severe hemorrhage and secondary traumatic shock. In one case oxygen carriers are completely removed from the body and in the other they are removed, at least temporarily, from the active circulation. Erlanger and Gasser⁵⁴ have shown that apparently one of the constant and important features of the pathology of shock is that the capillaries and venules of the intestinal villi are enormously distended by solid masses of red corpuscles. There is usually a marked reduction in the reserve alkalinity of the blood, and Cannon¹⁸ and others have emphasized the importance of the factor of an acute acidosis in this condition. Erlanger has shown, however, that shock is probably not essentially an acidosis, since the degree of shock and the extent of the acidosis are often far from proportional. With a view of combating the acidosis Dawson⁵⁵ in 1905, and Seelig, Tierney and Rodenbaugh⁵⁶ in 1913 employed alkalies in shock.

In cases of severe acute anæmia from hemorrhage practically all of the various classical signs of tissue asphyxia may be observed. These often, however, rapidly disappear, so that within a few days they may no longer be present. Mohr⁵⁷ has suggested that the fulfillment of the oxygen requirements in anæmia is due in part to an improved utilization of oxygen, as well as to an increase in the velocity of the blood-flow associated with a rise in the systolic output of the heart.

In cases of intestinal obstruction and in acute dilatation of the stomach, the classical features of tissue asphyxia are usually strikingly shown, at least locally. If the clinical picture of obstruction is due to a sudden occlusion of the circulation to the part, as, for example, in a mesenteric thrombosis or embolism, excessive peristalsis, as an effect of asphyxial acids, may precede the period of absence of peristalsis. Later the usual features of œdema and hemorrhage appear with finally necrosis. But even in cases in which the obstruction is not due to conditions which

frankly occlude a large artery or vein, it is nevertheless the disturbance in the circulation, and therefore in the oxygen supply of the affected tissues, that is chiefly responsible for the important effects. Even the excessive peristalsis which is practically always observed may be the response to the local acidosis. Extensive experimental evidence has been accumulated by American workers to show that the disturbances of the circulation are much more important in producing early severe symptoms and death than is the obstruction itself. The extensive oedema and extravasation of blood in these cases are conspicuous characteristics of the asphyxial process. These facts have especially been brought out in the excellent experimental work on intestinal obstruction by Murphy and Vincent,⁵⁸ Hartwell and Hoguet,⁵⁹ Whipple, Stone and Bernheim,⁶⁰ Murphy and Brooks,⁶¹ and by Brooks, Schumacher and Wattenberg.⁶²

In the condition of acute dilatation of the stomach, Woodyatt and myself⁶³ several years ago produced experimental evidence that here also the question of the asphyxia of the stomach wall is more responsible for the characteristic features than is the element of obstruction. This conclusion was based on the facts that, (1) a condition practically identical with acute dilatation of the stomach can be produced experimentally in dogs by measures which restrict its oxygen supply and (2) that an analysis of the gaseous and fluid stomach contents of such cases (both in the human and in the experimental animals) reveals products which are known to arise in disturbed oxidations. For example, the gas is chiefly CO₂ and the fluid contents contain much extravasated blood. The whole process seems to consist of a severe bloody oedema of the wall of the stomach with the extravasation of the fluid and gas chiefly into the lumen of the stomach.

Another clinical application of asphyxia as a cause of disease concerns that group of conditions sometimes spoken of as the hemorrhagic diseases of the newborn. It includes those affections of the newborn which are characterized by excessive fatty infiltration of the liver, oedema, a hemorrhagic tendency, and sometimes an associated icterus. Two of this group of affections are often referred to as Buhl's and as Winckel's diseases. It is interesting, however, that the former was described as early as 1813 by John Cheyne⁶⁴ and again independently in 1852 by Minot⁶⁵ of America, both of whom antedated Hecker and Buhl, and that the latter condition was described by the Frenchman, Parrot,⁶⁶ in 1873, six years before Winckel, by the Frenchmen, Laroyenne and Charrin,⁶⁷ in 1874, and by the American, Bigelow,⁶⁸ in 1875. In 1912 the writer⁶⁹ called attention to the marked resemblance which these conditions bear to an asphyxial process and showed by experiment that in guinea pigs all the characteristic features of these diseases could be produced by applying measures to the pregnant animal which would induce a severe asphyxia of the foetuses. It was considered likely that, in the human, protracted asphyxia of the foetus both from mechanical causes and from the use of chloroform during labor must be the origin of many of these cases.

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PART III

THE RECOGNITION OF ASPHYXIAL EFFECTS

Those effects of asphyxia which result in definite pathological lesions can, of course, be recognized by gross and microscopical examination of the affected tissues. The other type of effects, the physiological disturbances, usually require chemical methods for their detection. I shall discuss the principles rather than the details of these methods, since the latter are readily available in the literature. Of these physiological disturbances one of the most important is the phenomenon of acidosis, since most of the others are more or less intimately related to this condition. There are two clinical tests of some value in the recognition of a pronounced acidosis. One of these is the fruity odor of acetone on the breath. The other is the inability of the patient to hold his breath for more than a few seconds. Stange⁷⁰ noted that a patient who can hold his breath for only twenty seconds or less is a bad risk for a general anæsthesia. Although he attributed this fact to an impairment of the myocardium, Yandell Henderson⁷¹ later attributed the phenomenon to an existing acidosis and elaborated upon it as a convenient clinical test. The other methods of detecting acidosis have been outlined by Sellards⁷² in an attempt to group them in the order in which they might be expected to occur in the gradual development from normal conditions to a state of advanced acidosis. His outline is as follows:

1. Appearance of acetone bodies in the urine (for carbohydrate acidosis only).
2. Increase in tolerance to sodium bicarbonate.
3. Lowering of the carbon dioxide of the alveolar air and of the blood.
4. Change in reaction to phenolphthalein from alkaline to neutral of protein-free filtrate from blood serum.
5. Increase in output of ammonia in urine (usually normal in nephritic acidoses).
6. Increase in hydrogen-ion concentration of the blood.

Any one of these tests when taken alone has certain drawbacks in the recognition of acidosis, and the diagnosis should be supported by more than one. The appearance of acetone bodies in the urine, for example, is an indication only of impaired fat-metabolism, and furthermore, the absence of acetone does not necessarily imply the absence of an acidosis even of the type arising from a disturbance of the carbohydrate metabolism. A discussion of this question in relation to the acidosis of children is given by Howland and Marriott.⁷³ The increased tolerance to bicarbonate, which was used by Sellards in the recognition of acidosis, is said by him to be the most delicate of the tests which are specific. Under normal conditions the ingestion of sodium bicarbonate in as small an amount as 5 grams is soon followed by the excretion of some of this in the urine with the result that its reaction changes from acid to alkaline. In cases

of Asiatic cholera with nephritis, Sellards found that the urine frequently remained acid even after the intravenous injection of as much as 90 grams of the bicarbonate, whereas the injection of from only 3 to 5 grams in the normal was sufficient to render the urine alkaline.

The determination of the carbon dioxide tension of the alveolar air and of the blood is of very great value. For the former a very simple clinical method has been devised by Marriott.⁷⁴ For the latter the method most commonly used in America is that of Van Slyke, Cullen and Stillman.⁷⁵ A slight decrease, however, of the carbon dioxide tension of the alveolar air is not necessarily indicative of an acidosis; for, as Marriott, Sellards and others have emphasized, this may be lowered by an increased pulmonary ventilation and also by any change in the lungs or in the circulation which would interfere with the exchange of gases between the alveolar air and the blood. The change in reaction to phenolphthalein of the protein-free filtrate of the blood from alkaline to neutral has been suggested by Sellards as a convenient clinical method which possesses advantages over ordinary titration methods. It is fully discussed in the article by Sellards.⁷⁶ The study of the urinary output of ammonia has yielded results of the greatest fundamental importance in the development of our knowledge of diabetes and of disturbed carbohydrate and fat metabolism, but its value is inferior to some of the other tests in the recognition of an acidosis of a different type or where there is an associated impaired urinary excretion.

The determination of the hydrogen-ion content of the blood is now regarded in America as being of very little clinical importance. As has been said before, the reaction of the blood is one of the most constant and unalterable phenomena of the body. It is reasonable to suppose, therefore, that only the most extreme degree of acidosis would be accompanied by changes sufficient to be detectable. Experience has confirmed this. Of the American workers, Benedict⁷⁷ and Peabody⁷⁸ have been among the first to show it.

As has been stated elsewhere in this article, the phenomenon of acidosis is often intimately concerned with the question of renal excretion, especially because one of the most important routes of elimination of acid substances is by way of the urine. Certain clinical tests are therefore of value in determining the degree of impairment of the kidney function. Two methods, commonly used in America, which have been found to be particularly valuable in genito-urinary surgery are, (1) the method of Folin⁷⁹ for the determination of the non-protein nitrogen of the blood and (2) the rate of excretion of dyes, especially of phenolsulphonephthalein, as suggested by Rowntree and Geraghty.⁸⁰ The former test is based on the fact that in conditions of impaired renal function the elimination of non-protein nitrogenous products, as well as of other substances, is reduced and that therefore an accumulation of them in the blood occurs. These products include such known substances as urea,

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ammonia, uric acid, creatin, creatinin and the amino acids. Normally, they occur in an amount of from 25 to 30 milligrams in 100 c.c. of blood. In cases of marked impairment of renal function, as, for example, in threatened uræmia in prostatic obstruction, the amount of non-protein nitrogen in the blood may reach the high figure of 100 or more milligrams per 100 c.c. It is necessary to emphasize, however, that an exact knowledge of the diet is of the greatest importance in the interpretation of values in the above test. In regard to the determination of the excretion of dyes, the one most frequently employed in America, the phenolsulphonephthalein test, is based on the fact that in conditions of impaired renal function the rate of excretion is reduced. For details of the method the original article should be consulted. In normal individuals, if 1 c.c. of a solution containing 6 mg. of phenolsulphonephthalein is injected subcutaneously, from 40 to 60 per cent. of the dye is excreted within the first hour and from 60 to 85 per cent. is eliminated within the first two hours. In nephritic cases, particularly in threatened uræmia, the excretion of the dye may be as low as from 5 to 10 per cent. in the first hour.

Some Practical Methods of Minimizing the Effects of Asphyxia.—With the knowledge before us of the various ways by which asphyxia may be produced we can more certainly avoid the occurrence of asphyxial effects. Likewise in any condition in which a state of asphyxia is already pronounced we should scrupulously avoid any measures which would tend to aggravate it. This would imply that in any condition in which, for example, the oxygen intake is impaired, as in the early stages of an empyema, it should be remembered that the creation of an open pneumothorax for drainage, the use of a general anæsthetic agent (especially chloroform) will necessarily tend to increase the asphyxial effects. Also in conditions in which oxidations are already disturbed, as in diabetes, it is imperative that any anæsthetic agent used should increase those effects as little as possible. For this reason it would seem that chloroform should have no place in operations performed in the presence of such conditions. Likewise, in cases of acidosis with impaired renal function there is no doubt that chloroform is the most dangerous of the common anæsthetic agents. The idea which is sometimes expressed by surgeons that chloroform is less dangerous than ether in nephritic conditions is contrary to all the evidence available on the subject. The administration of chloroform particularly, and of ether to a less extent, is frequently followed by an increase of the urinary ammonia and by the occurrence of acetone in large quantities. It is an old observation that this effect is diminished if an abundance of carbohydrate has been ingested previously. Beddard⁸¹ has recommended the generous administration of carbohydrates to avoid "delayed chloroform poisoning." Opie and Alford⁸² also have shown that in mice the feeding of carbohydrates exerts a decidedly protective action against the development of liver necrosis by chloroform. In 1915 the writer⁸³ showed that the normal

relative insusceptibility of young pups to chloroform poisoning is due, at least chiefly, to the high glycogen content of their livers. These observations are all in accord with those of Roger⁸⁴ in 1892 on the protective action of the liver against strychnine and with those of Rosenfeld⁸¹ that animals fed upon carbohydrates are in general less susceptible to all those substances which produce fat accumulation in the liver. Of interest in this connection are the recent observations of the writer in association with Helen T. Graham⁸⁵ that sugars as a class retard the diffusion of acids through gelatin. It is well known that as long as a diabetic is oxidizing an average of 75 grams of carbohydrate in twenty-four hours the urine is free from β -oxybutyric and aceto-acetic acids, although it may contain small amounts of acetone.⁸⁶ The importance, therefore, of insuring that the liver is well supplied with glycogen by the administration of carbohydrate previous to undertaking an important operation is obvious. Conversely it is also obvious that a practice, still somewhat prevalent, of starving a patient for several hours before the operation and of withholding all food after the operation for two or three days, is dangerous. Glucose can be administered almost immediately after the operation to practically all patients by the rectum or in a 2 or 3 per cent. solution subcutaneously. It may also be given to advantage intravenously in concentrations of 5 per cent. or greater.

In conditions of already established acidosis of any type the administration of alkali in the form of sodium bicarbonate is helpful. Caution should be exercised, however, in the intravenous injection of it, for the reason that excessive quantities of alkali are in themselves toxic. The use of the bicarbonate should be controlled by a careful watch of the urine and should never be pushed beyond the point of neutrality or of slight alkalinity of the latter.

Another important matter is the copious administration of water. In order to insure the maximum elimination of acid it is essential that the urinary output be maintained to as nearly a normal degree as possible, or even to exceed the normal urinary elimination. Recently Woodyatt, Sansum and Balcar⁸⁷ have obtained striking evidence in favor of the view that fever is often an expression of a lack of "free" water in the body. Their work again serves to emphasize the importance of maintaining the water balance of the body. They emphasize also the desirability of giving fluids in the form of glucose solutions, because not only does the glucose itself provide food and exert an antiketogenic action, but also because "free," unbound, water is available after the sugar is consumed.

SUMMARY

Since respiration is one of the most fundamental properties of living matter, any interference with it leads to widespread and severe changes. By asphyxia in this article is meant not only an interference with the intake of air into the lungs, but also any disturbance in the free inter-

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change of oxygen and carbon dioxide in the tissues and any disturbance of oxidative processes which results in the formation of abnormal amounts of products of incomplete oxidation.

Asphyxial conditions may therefore be produced in any of the following ways: (1) An interference with the intake of air, (2) an interference with the power of the blood to carry oxygen or to remove carbon dioxide, (3) an interference with the circulation of the blood, and (4) a disturbance of the power of the tissues to utilize oxygen. All of these factors are of interest to the surgeon, and he may encounter all of them even in the same patient.

Interference with the intake of air is the result of not only obstructions of the upper air-passages but also of pulmonary disturbances which give rise to a diminished alveolar surface. These latter disturbances are due both to changes within the lungs, such as inflammatory exudates, and to abnormal pressures outside the lungs which limit their normal expansion. The principal agents which restrict the expansion of the lungs by pressure, are air and fluid.

The disturbances within the thorax which are caused by abnormal changes of intrapleural pressure are discussed in detail from the standpoint of new experimental work, as a result of which it seems evident that the previous, commonly accepted ideas are incorrect.

From the standpoint of pressure relationships the normal thorax may be regarded practically as one cavity instead of two. Any change of pressure in one pleural cavity is accompanied by practically an equal change in the other, so that an equilibrium of pressure exists at all times throughout the whole thorax.

The prevalent conceptions of pneumothorax are erroneous in that they are based on the assumption that when an opening is made into the chest one lung is collapsed and the other maintains respiration. This assumption implies that the mediastinum constitutes a rigid partition between the two pleural cavities. On the contrary, the mediastinum in the normal thorax is so mobile that any increase of pressure in one pleural cavity pushes it over into the opposite one so that both lungs are compressed practically equally. If, on the other hand, the mediastinum has been made rigid by induration as a result of long-standing inflammation, or if it has become fixed by adhesions, then a pleural opening on one side will not produce the same pressure changes in both pleural cavities.

The maximum opening into a pleural cavity which is compatible with life depends upon a definite relationship which exists between the amount of air entering the lungs and the amount entering the pleural opening. The maximum opening compatible with life may be approximately determined for the normal chest by the mathematical expression given in the text. By this mathematical expression it is found that an average normal man should be able to withstand for a short time an opening of about 64.8 sq. cm. (10 square inches); one with a "vital capacity" greater than

the average will be able to withstand a larger opening. There is harmony, therefore, between these results and the finding at the front that men were able to maintain respiration with gaping thoracic wounds which seemed surprisingly large.

A double open pneumothorax in a normal chest is more dangerous to life than a unilateral open pneumothorax merely because usually the combined areas of the two openings (and therefore the amount of air admitted into the pleural cavities) is greater than a single opening on one side is likely to be. Theoretically and experimentally effects of practically the same severity result in the case of one or more openings into one pleural cavity as follow the creation of a double pneumothorax, provided that in each case the combined areas of the various openings are equal.

The bearing of these results and deductions upon both the treatment of acute empyema and upon thoracic surgery in general is obvious. Whenever the amount of air taken into the lungs is limited by the presence of an active pneumonia, with plugging of both air channels and alveoli, whenever there is an excessive demand for air, whenever there is a sufficient weakening of the respiratory muscles to impair compensation, or, in short, whenever there is a marked reduction in the "vital capacity," the size of a pleural opening compatible with life becomes smaller; and if any or all of the above factors are present in sufficient intensity, even a very small opening into the pleural cavity will produce death from asphyxia. Since all of these factors are likely to be present to a high degree during the early stage of an empyema of the streptococcus type, early operation with the establishment of an open pneumothorax carries with it an unwarrantable danger. Either a method of repeated aspirations or one of closed drainage is indicated until after the above dangerous factors have disappeared.

Interference with the ability of the blood to carry oxygen or to remove carbon dioxide is of interest to surgeons chiefly in connection with anæmia, both acute and chronic, and perhaps rarely in poisonings of the type of carbon monoxide poisoning.

Interference with the circulation of the blood is of surgical importance not only locally in connection with the ligation or destruction of an artery, but also in heart disease, in shock, and in pneumothorax.

An inability on the part of the tissues to utilize oxygen is seen especially in narcosis with the common general anæsthetic agents and also in intoxications with acids, cyanides, etc.

The effects of disturbances of tissue respiration are both anatomical and physiological. The former consist, in general, of the syndrome of oedema, fat infiltration, hemorrhages, and necrosis. The physiological disturbances comprise the phenomenon of so-called "acidosis," changes in the respiration, glycosuria, etc. The importance of an impaired kidney function as a factor in the production of an "acidosis" is emphasized and discussed.

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The applications of these ideas to various definite surgical conditions are discussed, as, for example, in surgical narcosis, in intestinal obstruction and acute dilatation of the stomach, in shock, etc.

The principles underlying the recognition of many of these effects are discussed, as well as methods of minimizing them.

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SOME UNDERLYING PRINCIPLES OF INTESTINAL AND GASTRIC SURGERY*

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SURGICAL operations are done on living tissue and should be considered from this standpoint. Naturally, a knowledge of anatomy is essential, but merely following anatomical landmarks and making a beautiful dissection with accurately placed ligatures and sutures should not be the sole aim of the surgeon. This, to be sure, is properly included in the surgeon's ideals, but it is even more important that an operation shall result in the extirpation or correction of the pathology and in the restoration of the physiology of the tissues or organs involved. The physiology and pathology in the living are the chief biologic processes that should concern us in the planning of any operative procedure. It is often true that a patient may recover when but little regard is paid to these things, but the success of an operation should not always be judged by the fact that the patient survives. The eventual morbidity as well as the present mortality should be considered.

The biologic processes that follow surgical procedures are often given scant attention. Surgical drainage, for instance, is frequently regarded as solely or chiefly mechanical, though its action is largely biologic. The treatment of fractures by metal plates or screws produces beautiful immediate mechanical results, but a little study of the biologic processes that follow the use of steel plates and screws in bone should convince the surgeon that this is not a satisfactory operation. The effort to reverse the circulation of the blood by switching the arterial current into the veins has not been successful. Apparently, this was considered largely from a mechanical viewpoint, with the expectation that the continual pounding of the arterial current would break down valves that withstood the immediate arterial pressure. If the body were working solely on the principle of a machine, this would, of course, happen sooner or later. But it is a well-known physiologic law that when unusual work or strain is thrown on tissue or organs, one of two things happens: either the tissues or organs break down, or else they hypertrophy to meet the strain. This is what happens in attempted reversal of the circulation, as it can be determined experimentally that the valves of veins in an animal which do not break down in the first few minutes, apparently hypertrophy and form a permanent obstacle to the arterial current. Weeks after the reversal of the circulation, examination will show that the arterial current

* Read before the Kings County Medical Society, Brooklyn, New York, October 19, 1920. c

has gone no farther in the main trunk of the vein than it did the first few minutes after it was turned on.

The value of regarding the laws of physiology in surgery of the intestines and stomach is impressive. In the last two decades much has been discovered in the physiology of the stomach and intestines. The work of Keith, of Cannon, and of Sherrington, is of the greatest interest and has much practical bearing upon surgery. G. K. Dickinson, of Jersey City, has recently published an excellent discussion of the present views on the embryology and physiology of the intestines in a paper entitled "The Myenteric Nerve Net" (*Journal A. M. A.*, February 14, 1920, pp. 442-445). The value of preserving the physiologic functions of peristalsis becomes more evident with our increased knowledge of this subject. The obvious function of peristalsis is to propel fecal contents, but the action of the small regular peristaltic waves in emptying the branches of the veins and lymphatics in the walls of the bowel is highly important.

The obvious result of abolition of peristalsis of the bowel is obstruction. The cause of death in obstruction is undoubtedly due to toxæmia, though whether the toxic material is formed in the mucosa or within the lumen of the bowel is still a subject of some controversy. It is well known, however, that when mechanical obstruction has reached the point where there is distention and but little peristalsis, the condition of the patient is critical. It is also well known that handling of the bowel or exposure of its surface promotes intestinal paresis or paralysis. This may partly be due to evaporation of the carbon dioxide, as without the stimulation of carbonic acid in the substance of the intestinal wall the nerve net there ceases to act. Probably the direct handling and trauma incident to moving the intestinal coils in obstruction act also as an inhibitive factor for peristalsis. In obstruction of mechanical origin, nature's first effort is to overcome the obstruction by increasing the strength of the peristaltic waves. Naturally, after a time the musculature of the intestine becomes exhausted and eventually, if the obstruction is not relieved, the muscle is paralyzed from exhaustion and death ensues.

The old rule that in operations for obstruction the intestine must not be returned to the abdominal cavity until it has been thoroughly emptied has probably been the cause of much mischief. It is this unwise practice that has been responsible for the introduction of glass or metal tubes through an opening in the bowel and the threading of almost the whole length of the small intestine on such a tube in order to empty the bowel as far as the upper jejunum. This practice disregards the physiology of the intestines and particularly the physiology that occurs after obstruction. Even the opening of the abdomen under a general anæsthetic is followed by temporary paresis of the bowel. This may be a protective phenomenon intended to keep the bowel quiet so that a neighboring loop or omentum may plaster over the injured portion of the intestine and so prevent infection. It also provides physiologic rest. At any rate, the

phenomenon is commonly observed and is more pronounced with increased handling of the viscera. If, then, the whole length of the small intestine is forcibly threaded over a rigid tube, it can readily be imagined that the normal reaction would be a complete abolition of peristalsis for a considerable time. This paralysis of the bowel wall will probably do more harm in permitting the rapid accumulation of gas and of fecal contents from the excretory apparatus of the bowel than the immediate emptying will do good.

If the obstruction has reached such a stage that peristalsis is completely and permanently abolished, nothing can save the patient, but if there is still preserved a weak peristalsis, the performance of an enterostomy with as little trauma and exposure of the bowel as possible relieves the loop of bowel in which the enterostomy is done and will encourage the emptying of other proximal loops that still have sufficient peristalsis to expel their contents when both the pathologic and physiologic obstruction has been overcome by the enterostomy. The physiologic obstruction is obviated by avoiding the necessity of forcing the fecal contents along the normal intestinal tract below the enterostomy. But if a considerable portion of the bowel has been threaded over a metal tube, the manipulation of the intestine may completely abolish the weak effort at peristalsis that still remains. It is in such cases that an enterostomy with a rubber catheter, performed above the point of obstruction, gives the maximum chances of recovery.

For several years I have been doing an enterostomy that has given much satisfaction. It may usually be done under local anæsthetic and requires the delivery of only a few inches of an intestinal loop. If the loop is greatly distended and cannot be readily delivered, the method of J. W. Long is satisfactory, but the distention may often be overcome by packing around the coil and emptying the gas with an aspirating needle. In obstruction from mechanical causes there is a marked hyperæmia and often considerable free fluid in the peritoneal cavity. This gives a high degree of immunity against infection and even considerable soiling of the peritoneum under these conditions is harmless.

After delivery of the loop of intestine, intestinal clamps are placed about six inches from each other and the border of the bowel is grasped with mosquito forceps or Allis forceps about two inches from one of the clamps. A similar point is fixed near the other intestinal clamp, and while traction is made on these forceps to make the bowel between them taut, the bowel is incised. This should be done with a sharp knife and should go down to, but not through, the mucosa. The incision is two inches long. After separating the peritoneal and muscular coats from the mucosa, a purse-string suture of linen is placed at one end of the incision and the mucosa within the grasp of this purse-string suture is punctured. A medium-sized soft-rubber catheter, in which there are one or more additional perforations, is quickly inserted through this

puncture and the purse-string suture is tied snugly around the catheter. One end of the purse-string suture then transfixes the catheter to hold it in position. The catheter is buried on the exposed mucosa in the incision with a continuous right-angle suture. Before the catheter is inserted, it should be clamped at its end to prevent soiling. The loop of bowel may be confidently returned into the abdomen without fear of leakage. The enterostomy wound, however, should be near the parietal peritoneum. The catheter is fixed to the abdominal wall with adhesive to prevent unnecessary traction upon it. It is connected with a container in the usual manner. Through this catheter gas and fecal contents are easily emptied from the bowel, and peristalsis has not been interfered with in the other loops of the intestine. After ten days the catheter readily comes away and the valve-like mucosa, which has been formed on the principle that Coffey has enunciated in transplantation of the ureter or common bile-duct, will in many cases prevent the exit of fecal contents after the catheter has been withdrawn. Even when fæces flow for a few days, the amount is small and soon ceases.

The operation of lateral intestinal anastomosis is admitted to be physiologically wrong, even by its most ardent supporters. The work of Cannon and Murphy (*ANNALS OF SURGERY*, vol. xliii, pp. 519-520) has conclusively shown that in lateral anastomosis peristalsis in the region of the anastomosis is practically abolished, and food can be pushed through the anastomotic opening only when a column of it extends into a proximal (oral) loop where peristalsis is unimpaired. This is true because severing the circular muscular fibres in lateral anastomosis abolishes peristalsis in that region and the blind pouches at the ends cannot be completely emptied. These investigators found that in end-to-end union of the intestine there is not the slightest stasis of intestinal contents at the site of operation. Many patients with a lateral anastomosis are able to overcome the handicap of the unphysiologic procedure and have no symptoms. This, however, is by no means always true, and the cases reported by Moore and others show that the complications following this operation may be extremely serious. (*Transactions Southern Surgical Association*, vol. xxxi, pp. 152-153.)

The chief objection to end-to-end union of the intestine has been that the suture line is likely to leak either at the mesenteric junction of the bowel or at a point opposite to this, where the nutrition is poor. I have elsewhere attempted to show that while the triangular space where the mesentery splits to envelop the bowel has been considered responsible for most of the failures of end-to-end union of the intestine because it is devoid of peritoneum, the real cause for failure is infection. W. J. Mayo has repeatedly stated that for successful union peritoneum is only needed on one side, and this mesenteric space is usually carefully sutured by every operator before the operation is completed. The great trouble is that many surgeons who have had disastrous experiences in end-to-end union,

infect this area when the lumen of the bowel is opened. They cut the bowel from the free border toward the mesentery and then clamp and suture the triangular space. Dividing the bowel in this manner necessarily carries the contents of the bowel into this space, because the blades of the scissors that cut through the lumen of the bowel must be contaminated with fecal contents and will smear bacteria into this space. When the operation is completed, this region is carefully sutured and later, when leakage occurs here, it has been assumed that the leakage is due to lack of peritoneal covering. If we were to dip a platinum loop into fecal contents and smear it into an incised wound on the hand, and then later suture the wound very carefully, we would not be surprised when the sutures broke down. It is for the same reason that leakage occurs at the mesenteric triangular space, which is composed of loose tissue, rich in lymphatics and small blood-vessels, and when once infected can hardly be sterilized.

Another point of leakage is at the border opposite the mesenteric border, and here, if the nutrition has been preserved and the infection is not overwhelming, leakage should not occur, provided the sutures have been properly placed. The ends of the bowel before suturing should be cleaned, using gauze wet with antiseptic solution and making an effort to disinfect the mucosa of the intestine in the same general manner as we would the skin before incising it. It may be impossible to sterilize the mucosa of the intestine, just as it is impossible to sterilize the skin by any known method that does not destroy the skin, but certainly the majority of the bacteria can be removed, and then the needle and thread will not carry the infection as they do if the fecal matter is simply squeezed out and no further effort is made to clean the bowel ends. Leakage opposite the mesenteric border in end-to-end union of the colon may be due to lack of cleaning the bowel ends, and so preventing infection where the nutrition is weakest. If the colon is not made as nearly aseptic as possible, when the thread pierces its lumen it carries bacteria through the whole tissue. This may account for the poor healing and the late infection of the stitches that have sometimes been noted after resection of the colon. If the end of the bowel is cleaned, fecal matter when turned on after removing the intestinal clamps will only contaminate that portion of the thread within the lumen, and there is less chance of infection from the thread that is already buried in the tissues of the bowel wall.

Then, too, end-to-end union after resection for cancer of the colon permits removal of more of the bowel than lateral anastomosis, which is sometimes a great advantage.

In an effort to overcome these objections, I have worked out a method for resection of the small intestine which in my hands has been quite satisfactory (*Southern Medical Journal*, vol. viii, p. 298). According to this technic, the loop containing the diseased bowel is clamped and emptied as far as possible. The mesentery is first divided close to the

bowel and the triangular space at the bowel is clamped and tied. The rest of the mesentery is then divided and its vessels are tied. Moist gauze is packed under the loop and the proposed site of resection is carefully isolated with moist gauze. After clamping the loop near the proposed point of resection, the bowel is cut somewhat obliquely from the mesentery outward. The end of the bowel is carefully cleaned with gauze

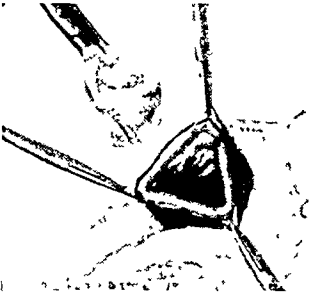


FIG. 1.—After the mesentery of the bowel has been divided and tied, and the triangular space at the mesenteric border closed with a ligature, the bowel is divided from below upward. The end is carefully surrounded by moist gauze caught with forceps and cleaned out with gauze wet with an antiseptic solution.



FIG. 2.—The suturing is begun by a mattress suture, the short end of which is left clamped and the long end continued across the mesenteric border of the bowel. Care is taken to include the stumps of the ligated triangular space in this suture. When a third of the circumference has been sutured, the thread is changed to a right-angle continuous stitch.

dipped in bichloride solution (Fig. 1). The other end of the loop is cut away and the end of the bowel similarly cleaned. The bowel ends are united by a linen or silk thread on a straight needle, which begins as a mattress suture with the knot on the mucosa of the right-hand end. This is continued back and forth across the mesenteric portion, going well below the margins of the bowel with the sutures snugly drawn. When

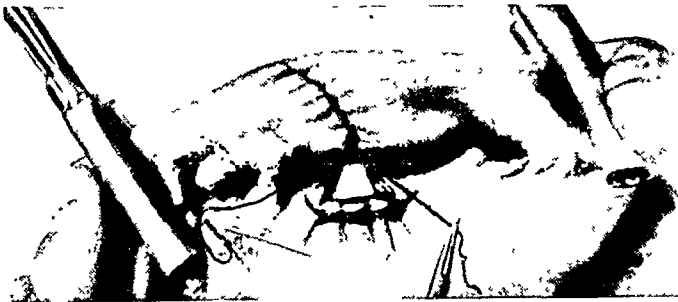


FIG. 3.—The suturing has been completed and the threads are about to be tied.

about one-third of the circumference of the intestine has been sutured, the needle is brought through from the lumen of the bowel to the peritoneal surface and a back stitch is taken. The rest of the suture is completed as a right-angle, continuous suture, turning in a small margin of the bowel with each stitch penetrating to the lumen in order to secure a firm hold (Fig. 2). A back stitch is taken at every third or fourth stitch. When the point of beginning has been reached, one stitch farther is taken

beyond the point of commencement and on the left side of the bowel if the knot is on the right side (Fig. 3). The suture is then tied snugly three or four times to the original short end which was left clamped, and the ends are cut short.

In resection of the cæcum and ascending colon, the same general principles are involved, except that it seems wise to follow nature's lead and provide a valve similar in action to the ileocecal valve which will prevent the flooding of the lower portion of the small intestine by the contents of the colon with each retrograde peristaltic wave. This is carried out by a modification of the end-to-end operation which has just been described (ANNALS OF SURGERY, January, 1919, pp. 25-30). After mobilizing the

bowel and separating the mesentery, a suture is begun from the colon side, and instead of uniting the edge of the colon to the edge of the ileum, it unites the edge of the colon to the ileum about an inch back of its end. In this way a small amount of the ileum projects into the lumen of the colon and the external longitudinal fibres pull back the mucosa as a cuff, so that but little peritoneal surface of the ileum is exposed in the lumen of the colon. In this operation, and in all operations upon the large bowel, or where there has been marked obstruction, an enterostomy according to the method described should be done. A small-sized catheter is all that is necessary to give exit to gas (Fig. 4). This may be introduced through a stab wound in the abdominal wall before the catheter is placed in the bowel, and if the end is clamped there will be no occasion for infecting the abdominal wall by the contents of the bowel.

In resection of the cæcum, it is wise to surround the line of sutures with omentum, which is always at hand in this region. On the left side in resection of the colon a tube introduced through the rectum and carried through the anastomosis after it has been completed and possibly held in position by a single suture a short distance above the anastomosis, accomplishes the same thing as an enterostomy does on the right side. This suture can be buried by another suture. If the tube is not fastened in this manner it will soon be extruded. The great value of an enterostomy or of a tube through the rectum in resection of the large bowel is because of the distention that follows these operations. This distention not only causes discomfort, but produces so much pressure on the stitches that it retards healing and may cause the stitches to cut. By reducing the pressure the bowel is placed at physiologic rest and in the best condition for healing.

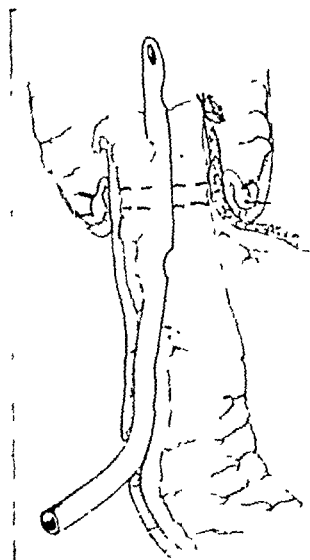


FIG. 4.—Cross section of the completed union between the ileum and stump of the colon after resection of the cæcum and ascending colon. Note the position of the tube, which is inserted from the ileum instead of from the colon, as was originally recommended. The valve-like action of the mucosa usually prevents leakage when the tube is withdrawn.

In surgery of the stomach physiologic principles are also valuable. I shall only take up one feature of stomach surgery, the treatment of ulcers of the stomach and duodenum. The usually applied surgical therapy for ulcer of the stomach or duodenum is gastroenterostomy. That this method is not entirely satisfactory from a clinical standpoint alone will probably be evidenced by anyone who studies the ultimate results of his own cases of gastroenterostomy for ulcer, or who goes over the carefully prepared statistics of large clinics, especially if these statistics are written from a medical viewpoint; for it is to the internal medical man that the complaining patient who has undergone gastroenterostomy usually returns. Thus, Frank Smithies, formerly gastroenterologist to the Mayo Clinic, and at present at the Augustana Hospital in Chicago (*Surgery, Gynecology and Obstetrics*, vol. xxvi, March, 1918, pp. 275 *et seq.*), has reported two hundred and seventy-three cases of gastroenterostomy, with only 20.9 per cent. of the patients clinically complaint free. These statistics, too, were in a paper that was not primarily critical of gastroenterostomy.

It is obvious that gastroenterostomy for duodenal or gastric ulcer does not restore the stomach to its normal physiologic condition. It is also obvious, and has been demonstrated by Cannon, Blake and others, that gastroenterostomy is not a drainage operation, and unless the pylorus is closed, some food continues to go by that route. The stomach is doubtless supplied with sensory nerves as shown by Kast and Meltzer, Ritter and others. These nerves terminate in the muscular coat of the stomach and do not reach the mucosa. The pains which come on with such clock-like regularity after meals in duodenal or gastric ulcer are due to the pressure of peristalsis on these gastric nerves which are made unusually sensitive by the inflammation of the ulcer. Consequently, they register impulses of pain from the pressure of peristalsis that in a normal physiologic condition they would not register. The character of the gastric juice has nothing to do with the pain except so far as it excites peristalsis. Gastroenterostomy probably relieves the pain of a gastric or duodenal ulcer by facilitating the emptying of the stomach and so lessening peristalsis. It is also probable that a small amount of jejunal contents regurgitates into the stomach and decreases the acidity of the gastric juice and thereby lessening the peristalsis which is excited by a hyperacid gastric juice. This, however, is not removing the cause and restoring the physiologic conditions, but is merely treating a symptom when the pain is relieved by gastroenterostomy.

The jejunum is physiologically accustomed to alkaline contents. The acidity of the gastric juice is neutralized in the first portion of the duodenum and when the food reaches the jejunum it is always distinctly alkaline. When the acid contents of the stomach are dumped directly into the jejunum, as after a gastroenterostomy, it is natural to expect some reaction on the part of the jejunum against this change from an alkaline to an acid medium. If the urine continued alkaline for several days,

there would probably be a cystitis, and the best method of curing the cystitis is to make the urine acid and so let the bladder contain a medium for which it is physiologically fitted. The pouring out of acid into the jejunum, which is physiologically fitted only for alkaline medium, will naturally produce changes in the jejunum and in all probability a reaction of some kind as a protest against this unphysiologic change. In large clinics jejunal or gastrojejunal ulcers are reported as a late complication in from 2 to 4 per cent. of the total numbers of gastroenterostomy. It seems probable that for every jejunal ulcer there must be many more instances of some reaction to the acid medium on the part of the jejunum, such as chronic hyperæmia, that will be sufficient to produce symptoms, though the symptoms may not be very severe. It is likely that the symptoms caused in this way account for the small percentage of complaint free cases found in carefully traced gastroenterostomy patients. These complaints often do not arise until months or years after the operation, when the jejunum is no longer able to withstand the continued irritation of the acid.

It is well recognized that the most satisfactory results after gastroenterostomy follow stenosis of the pylorus. When there is marked stenosis or extensive infiltration which will probably produce stenosis, the gastroenterostomy opening is eventually the sole exit of the gastric contents. The duodenal contents then retains its maximum alkalinity, which is delivered at the gastroenterostomy opening unimpaired and will readily neutralize the acid of the stomach. In this manner the jejunal mucosa is protected from the acid of the stomach. But when the pylorus remains patent or when it becomes patent after a temporary closure, the alkalinity of the duodenum is impaired by that part of the gastric juice which gains exit through the pylorus, so it cannot fully neutralize the acid that comes through the gastroenterostomy opening; and so the jejunum is not sufficiently protected from the acid. In these cases, then, and obviously in inoperable cancer of the pylorus, gastroenterostomy is a satisfactory operation, but these form a comparatively small number of the cases of gastric surgery. In duodenal or gastric ulcers that can be excised and in a narrow stenosis a pyloroplasty that will return the stomach as nearly to its normal as possible seems more desirable than a gastroenterostomy that continues an unphysiologic condition.

There is one part of the body in which an ulcer in the region of the sphincter has been the object of surgical observation since the earliest time, and the treatment of this condition has been satisfactorily standardized. This is an ulcer or fissure in ano. The analogy between an ulcer in ano and a duodenal or pyloric ulcer of the stomach is very striking. The necessity for paralyzing the sphincter and because it holds an ulcer within its grasp is obvious, for this produces physiologic rest of the tissues. In an ulcer high up in the rectum, paralysis of the sphincter prevents distention of the rectum and back pressure on the ulcer, and causes

a ready emptying of the bowel without the necessity of strong peristalsis. So it is with the tissues in the sphere of influence of the pyloric sphincter after the ulcer is excised. The pyloric sphincter and its adjuvant muscular fibres in the pyloric end of the stomach should be temporarily put out of commission. This, too, is indicated in ulcer in the body of the stomach, so that the stomach can empty its contents readily without having to overcome the physiologic obstruction of the pylorus.

In order to meet these indications, I have been doing a pyloroplasty which is founded upon an effort to remove the pathology by excising the ulcer, to place the tissues at physiologic rest during healing, and, as a late result of the operation to restore them to physiologic normal. This operation is founded upon the principle of making an incision not longer than an inch into the duodenum and of carrying the incision into the stomach not less than twice the distance of the incision in the duodenum. When the ulcer is in the body of the stomach, the incision into the duodenum need be no longer than one-half inch, and into the body of the stomach no longer than an inch. It is best to make the stomach incision first if the ulcer is in the duodenum and then expose and excise the ulcer from within (Fig. 5). Ulcers in the duodenum more than three-fourths of an inch from the pylorus are not fitted for this operation and should be excised transversely and the wound sutured as an ordinary intestinal wound. This has been the practice of Judd of the Mayo Clinic, with this type of ulcer, and he has had excellent results. The pyloroplasty wound is closed transversely first by two stay sutures, then by a continuous tanned catgut suture which unites the mucosa, a second row of continuous tanned catgut sutures which merely approximates the peritoneal and muscular coats without attempting to invert them, and then a third row of sutures of fine tanned catgut is placed as a right-angle suture, inverting the other two rows (Figs. 6 and 7). Finally, a tag of gastro-colic or great omentum is brought up over the suture line and fastened in position with a few interrupted sutures of fine tanned catgut.

It is essential in a pyloroplasty to remove a diseased or adherent gall-bladder and to cover raw surfaces carefully, for there is more tugging on duodenal or pyloric adhesions after a pyloroplasty or in a normal stomach than after a gastroenterostomy. The patient should be chiefly on his left side after operation.

This operation differs from the Heineke-Mikulicz in many respects, resembling it only in that in both operations the pylorus is divided and the incision is approximately straight. The Heineke-Mikulicz was conceived on well-known plastic principles to overcome stenosis of the pylorus, but this pyloroplasty is intended to put at physiologic rest the tissues as they are healing. The incision is differently placed from the Heineke-Mikulicz, and rests on the principle that there must always be two parts of the incision in the stomach to one in the duodenum, which gives an excellent view of the pyloric end of the stomach and can be

extended into the stomach almost indefinitely. It requires a rather definite technic to be closed satisfactorily, and when it is closed the ends are in healthy stomach wall and not in a mass of scar tissue, as after the closure of a Heineke-Mikulicz for stenosis. Then the location of the incision and the application of the omentum prevent the pylorus from being drawn up under the liver, as often happens after the Heineke-Mikulicz.

The proof of any therapeutic measures, however, is in the eventual result. I have done twenty-three of these pyloroplasties. Eleven of these cases were reported in the *Journal of the American Medical Association*, August 23, 1919. In the first twelve cases there were three deaths. Two of them were explained very fully in the article mentioned. One was



FIG. 5.—The line shows incision for pyloroplasty which should always be two parts in the stomach to one in the duodenum.

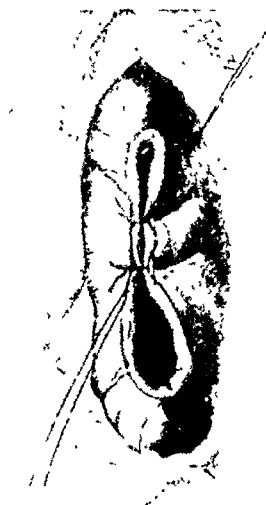


FIG. 6.—Two tractor sutures are placed. The first one unites the extremities of the incision and the second is only one-half inch above the first suture. Originally they were placed too far apart.

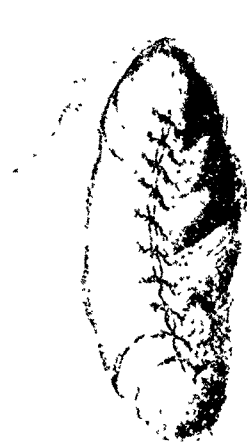


FIG. 7.—The mucosa has been united with a continuous lock stitch of tanned or chromic catgut. The second row of sutures is shown in this illustration. It merely approximates the cut edges of the muscular and peritoneal coats. No effort is made to turn in tissue with this second row of sutures as was originally shown. The third row, however, is a right-angle suture of fine tanned catgut, and invaginates the other two rows.

due to a secondary hemorrhage from an ulcer in the body of the stomach twenty-one days after the operation, and was in no way connected with the pyloroplasty. The other death was from a secondary hemorrhage on the eighth day after the operation from too deep division of a cicatricial band in the pylorus. I think both of these deaths could be avoided now. The third death was the twelfth operation and was due to uræmia. In all of these patients a post-mortem examination of the abdominal viscera was made and no one could hold the pyloroplasty for the fatal results. Since that time there have been eleven consecutive cases without a death.

For the first few months after operation, the results from this pyloroplasty do not differ greatly from the results after gastroenterostomy. It is only when the action of the gastric juice on the jejunal mucosa has set up irritation many months after gastroenterostomy that the ultimate clinical results show the advantage of the pyloroplasty over gastroenterostomy.

Since January 1, 1912, I have done fifteen resections of the small

bowel according to the technic described. There were four deaths, all following resection for obstruction. In all four of these cases the patients were in a desperate condition, one death occurring three hours and another six hours after resection. The third fatal case followed five days after the resection, which was done in the presence of suppurative peritonitis. The fourth death was in a patient sixty-eight years of age for whom I had done, under local anæsthetic, a resection of gangrenous bowel due to strangulated hernia. The ligated triangular spaces of the mesentery were not caught with the continuous mattress suture as they should have been. They retracted, and an abscess formed, which, though small, caused obstruction, toxæmia and death. Thirteen of the total number of resections were for obstruction due to bands, volvulus, mesenteric thrombosis, or strangulated hernia. Among those who made a satisfactory recovery are three patients aged, respectively, sixty-seven, sixty-nine, and seventy-three years, in each of whom resection was done under local anæsthetic for gangrenous bowel from strangulated femoral hernia.

During the past twelve years I have done ten resections of the cæcum and ascending colon without a death. In all of these cases the principles of end-to-end union, ligation of the mesentery and its triangular space before opening the bowel, and cleaning the ends of the bowel before suturing, were carried out. The Barber operation was performed in one case. In four cases the valve formation was done. In the last three cases the technic as described with enterostomy and valve formation was fully carried out, and the absence of distention and the smooth convalescence were noticeable in each of these patients.

SOLID TUMORS OF THE MESENTERY

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AND

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SOLID tumors of the mesentery, though frequently described, are of sufficient rarity to warrant individual case reports, particularly when the case presents unusual features. In examining the reported cases there is a striking similarity in certain salient points in the histories. The diagnosis is rarely made, even in cases unaccompanied by obstruction. The mortality in the operated cases is extremely high, and the question always comes up at operation whether to remove the tumor from the mesentery or to do an intestinal resection.

Arising as they do from the connective tissue within the mesenteric leaves, these tumors are invariably of the connective-tissue type of tumor; fibroma, fibro-myoma, lipoma and sarcoma. One case has been reported of a neuro-fibroma. The few reported cases of carcinoma are undoubtedly secondary to a primary carcinoma of the intestinal wall, spreading into the mesentery by continuity of tissue. The primary retroperitoneal sarcomata which grow between and push apart the leaves of the mesentery must be both clinically and pathologically differentiated from the primary mesenteric sarcoma. Pathologically the primary mesenteric sarcomata are nearly always fibro- or spindle-celled, while the primary retroperitoneal sarcomata which secondarily invade the mesentery are, as a rule, small or large round-celled.

The first mesenteric tumor successfully treated by operation, a cyst was reported by Tillaux,¹ in 1880. In an exhaustive study in 1906, Vance² collected 27 cases reported in the five previous years. Of these, 7 were sarcomata, 1 carcinoma, and the rest benign tumors of neoplastic origin. In the 27 cases in which operation was done, 11 died, a mortality of 40.7 per cent. Resection of the overlying bowel was done in 13 cases, with a mortality of 46 per cent. From these figures it is evident that intestinal resection only slightly increases the mortality of the operation. An interesting feature in Vance's cases is that of the sarcomata coming to operation, only one survived the operation. Since Vance's article, numerous individual cases have been added to the literature.

Without an exhaustive study of the literature, we have been able to collect about fifteen subsequent cases. A striking feature in all is the almost invariable failure to make a diagnosis, and the entire absence of the X-ray reports.

In those cases which appear with the syndrome of an acute intestinal obstruction, diagnosis is out of the question, as the symptoms of ob-

struction entirely mask the underlying condition. In cases, however, in which the operation is done *a'froid*, the diagnosis should at least be suspected. These tumors have one feature in common, that is their mobility. In nearly all instances, except where it springs from the rectosigmoid junction, the tumor is freely movable and can be pushed from side to side

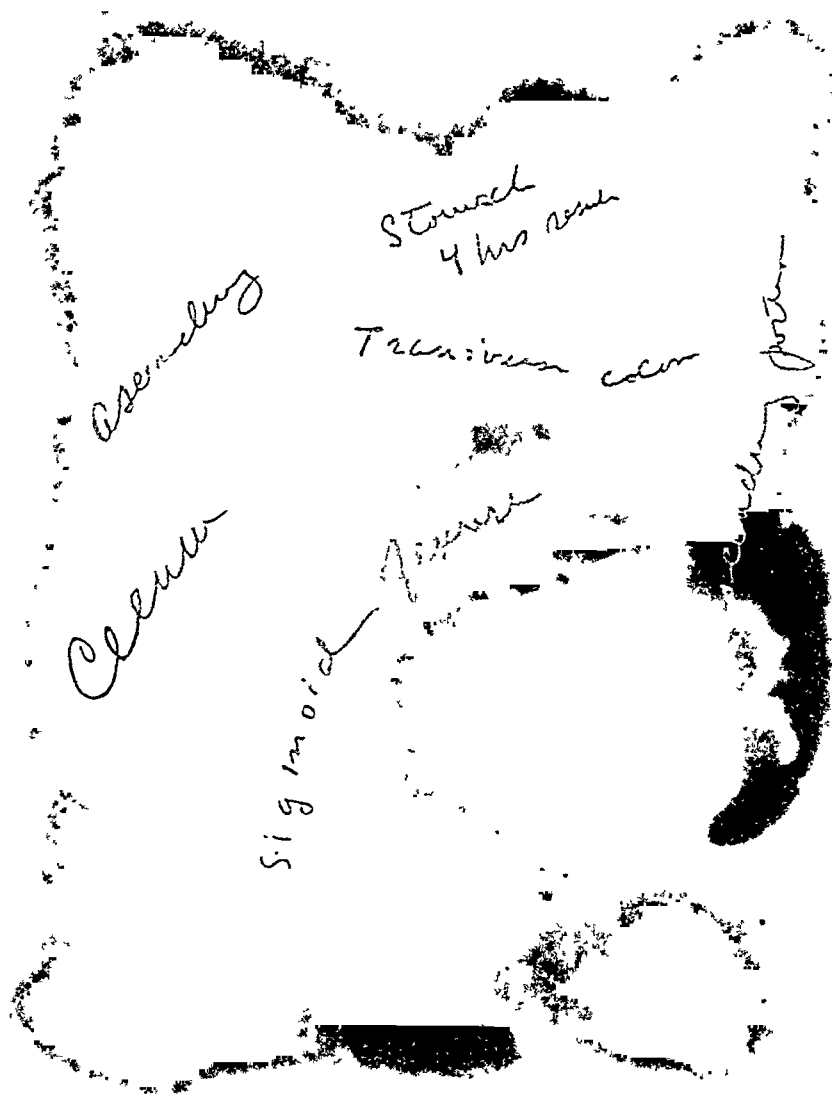


FIG. 1.—Conditions revealed by X-ray in case reported.

in the abdomen; as a rule, painlessly. This mobility they have in common with most ovarian cysts, omental cysts and pedunculated fibroid tumors. The age of incidence is of no significance in the diagnosis, as these cases have been reported at all ages.

Biglow and Forman³ reported a case in a child of six years. Bilisario,⁴ a case of mesenteric cyst in an infant less than a year old. In Bevan's⁵ case, in spite of the enormous size of the tumor, the diagnosis before

SOLID TUMORS OF THE MESENTERY

operation lay between a mesenteric sarcoma and an omental cyst. For self-evident reasons the diagnosis of these cases is far more difficult in women than in men. The X-ray findings of extreme importance, except in tumors springing from the small intestines, since these have neither definite anatomical nor X-ray location. However, the large intestine, both from an anatomic and X-ray standpoint, has a well-defined position, and any gross variations are easily detected, even in the absence of obstruction. For example, a normally filled transverse colon, with a sharp curve deflected upward, combined with a movable tumor in the central abdominal area, would certainly suggest a tumor of the transverse mesocolon. In the same way, a movable tumor in the lower left abdominal quadrant, combined with a radiographic picture of unusual sigmoid looping, would undoubtedly suggest a tumor of the mesosigmoid.

An important question which can only be settled during the operation is that of intestinal resection. Though resection undoubtedly slightly increases the operative mortality, it must be done if there is any doubt as to the viability of the bowel. In Biglow's case the failure to resect was proven by post-mortem to be the cause of the fatality, as there was a necrosis of the intestine following an interference with its nutrition. These tumors are usually so closely connected with the blood supply of the overlying intestine that there is great danger in interfering with the viability of the bowel through the removal of the tumor. As in strangulated hernia, if in doubt, resect.

Male, aged seventy-three years. After a marked dietary indiscretion, had a good deal of epigastric distress. While examining the abdomen, a large tumor mass was discovered in the lower left quadrant. This mass was about the size of an orange, and did not seem to be movable. It was smooth in outline and exceedingly hard. The patient, himself, was unaware of its presence. The mass was not tender to pressure and the intestinal coils could be slipped over it. It was not adherent to the abdominal wall. The inguinal glands were enlarged and hard on the left side. They were palpable but smaller on the right side. The prostate was hard, firm, perfectly smooth, and considerably enlarged. The seminal vesicles were normal. No definite connection could be traced between the abdominal mass and the genito-urinary tract. The physical examination otherwise showed the heart to be normal for a man of the patient's years. The lungs were normal.

X-ray examination (Fig. 1) had the following results:

Thoracic and Gastro-Intestinal Examination:

Lungs.—Hilum shows shadows increased. Bronchial tree prominent. Parenchyma transparent. Diaphragmatic excursions not impaired.

Heart and Aorta.—In normal position and of normal size. Thoracic aorta dilated.

Æsophagus.—In normal position and not obstructed.

Stomach.—Size medium. Position, cardiac to left, middle portion in

front, pyloric end to right of spinal column. Greater curvature about two inches above crest of ilium. Hypertonic, steer-horn in shape, no adhesions, no filling defects, no tenderness. Pylorus dilated. Pyloric sphincter spasmodic. Peristalsis sluggish.

Duodenum.—Visualized after considerable manipulation. Duodenal bulb triangular in shape and regular in outline.

Gall-bladder.—Not visualized.

Liver and Spleen.—In normal position and not enlarged.

Four Hours Later.—Considerable residue in the stomach.

Barium Enema.—No obstruction encountered along the course of entire colon. The sigmoid flexure is elevated and displaced to the right by a mass which is extrinsic. Cæcum is redundant. No tenderness.

Urine Examination.—A.M.—Albumen and sugar negative. Microscopical: Uric acid and large quantities of oxalate of lime. P.M.—Albumen and sugar negative. Microscopical: Granular and hyaline casts. Large round epithelial cells in very considerable numbers. Red blood-cells. White blood-cells. Oxalate of lime.

Blood Examination.—Red blood-cells, 5,200,000. White blood-cells, 9600. Hæmoglobin, 100 per cent. Differential: Polys., 143-71.05 per cent. Large monos., 17-8.05 per cent. Small monos., 35-17.05 per cent. Eosinophiles, 3-2.05 per cent. Transitionals, 2-1 per cent. Strained specimen shows characteristics of mild degree of secondary anæmia.

Diagnosis.—Mesenteric tumor, probably malignant, lower left quadrant.

In spite of the lack of characteristic mobility, the diagnosis was made by exclusion, the deformity of the sigmoid loop pointing conclusively to the diagnosis. The reason for the lack of mobility here was the fact that the lower part of the tumor was locked in the pelvis. Operation, Jewish Hospital, January 17, 1920; gas oxygen anæsthesia; tumor the size of fetal head was found in the mesosigmoid, just above the rectosigmoid junction. The sigmoid was flattened over the tumor like a ribbon. The left leaves of the mesentery were split and the tumor easily enucleated. This, however, seemed to interfere with the viability of the sigmoid loop, which had been over the tumor. Twelve inches of the sigmoid were resected, and an end-to-end anastomosis made. This anastomosis was technically difficult, as it was made at the rectosigmoid juncture. The anastomosis was covered with a free omental graft. Two cigarette drains were left at the site of the anastomosis. The rest of the wound was closed. Seven days after operation the bowels were moved with an enema. Four days later a small fecal fistula developed, which, however, closed automatically. February 4, 1920, further convalescence was uneventful. *Pathological report*: Fibro-sarcoma.

NOTE.—Since writing the above, the patient presents symptoms of a recurrence.

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STAVE FRACTURE OF THE FIRST METATARSAL BONE

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STAVE fractures of the metatarsal bones are rare. No mention of this type of fracture is made by Cotton, Scudder, Stimson, Moorehead, DaCosta or Keene. A stave of the metacarpal bone, on the other hand, is fairly common, that of the thumb being called Bennett's fracture. A stave of the thumb usually results from violent force applied to the distal end of the extended thumb. It is a fracture of the proximal end of the metacarpal, oblique or longitudinal and into the joint with the trapezium. There is, usually, a backward dislocation of the first metacarpal bone.

The case to be described is a stave at the base of the first metatarsal bone, and into the articulation with the internal cuneiform.

J. H. G., colored, aged thirty-five years, employed as a laborer in a warehouse, pulling a four-wheeled truck. When loaded, this truck requires two men to move it, one in the rear pushing it and one in front pulling by means of a handle. In going down a slight decline in the warehouse, one of the wheels of the truck struck the back of the elevated heel of the right foot. The ankle-joint was severely wrenched. He had to stop work immediately because of pain in the ankle-joint and foot. The patient was seen about a half hour after the accident and the following was noted: The injured foot showed a third degree of pes planus. The opposite foot, examined for comparison, also showed this deformity. The astragalo-scaphoid joint of the affected foot bulged inward and downward. The inner border of foot was markedly convex. The ankle-joint, on its anterior and lateral aspect, was swollen. The movements of the foot were painful, especially plantar flexion, abduction and eversion. Palpation revealed an area of pain and tenderness on the inner border of the base of the first metatarsal bone and at the insertion of the tibialis-anticus tendon. There was considerable pain and tenderness to pressure beneath the internal malleolus, indicating a sprain of the internal lateral ligament. No crepitus was elicited. The X-ray showed an oblique fracture of the base of the first metatarsal.

The mechanism in the production of this fracture differs from that of the thumb, in that the violence is transmitted through a series of bones (the mid-tarsum), finally spending its force upon the principal pillar of the fore-foot, the strong first metatarsal. The fracture produced is therefore due to indirect force.

When the impact of the violence is received upon the back of the heel, the foot is in plantar flexion and weight is momentarily borne upon

the anterior metatarsal arch and toes. There is a sprain of the capsular ligament of the ankle-joint at its attachment to the anterior margin of the lower anterior border of the tibia and perhaps also the margin of attachment to the astragalus. There is also some strain put upon the lateral ligaments. The violence is diffused forward, downward, inward and upward. There is an anterior subluxation of the astragalus. The



FIG. 1.—Stave fracture of base of first metatarsal bone

head of this bone is forced downward and inward upon the scaphoid, carrying the latter with it. The strong inferior calcaneo-scaphoid ligament being relaxed in this case, owing to the deformity, does not resist the strain. The internal cuneiform bone receives this violence, and it in turn is jammed against the base of the first metatarsal bone. The latter, being the last bone in the line of force, does not move anteriorly because it rests on the ground. Dislocation backward does not occur; and inward displacement is restricted by the peroneus-longus muscle which is inserted into the inferior surface of the base. The first metatarsal bone, caught between these forces, will fracture at the base.

An accurate diagnosis of these cases cannot be made unless the X-ray is employed. The symptomatology of this type of injury is rather severe because of the extensive injury to the

capsule and the lateral ligaments of the ankle-joint.

The treatment of a stave fracture of the first metatarsal is to supinate and adduct the foot at right angles to the leg and immediate immobilization in this position by means of plaster of Paris for about two weeks, followed later on by baking, massage, passive and active movements. Weight may be borne about the end of a month.

TUMORS IN SOUTH CHINA

BASED UPON RECORDS OF OPERATIONS PERFORMED IN THE CANTON HOSPITAL
DURING THE TEN YEARS 1910 TO 1919.

By J. OSCAR THOMSON, M.D., C.M.

OF CANTON, CHINA

SURGEON TO THE CANTON HOSPITAL

CANTON, the capital city of Kwongtung Province and the largest city in China, with a population of more than one and a half millions of people, is situated upon the Pearl River, ninety miles from the sea, upon the northern border of a great delta, in Lat. 23 degrees 7 min. North, and Long. 113 degrees, 14 min. East. It is the port for several of the neighboring provinces as well, with a population of fifty millions.

The climate is subtropical. During the past ten years the maximum summer temperature was 101° , the mean 85.53° and minimum 65° , with humidity averaging about 99. The minimum temperature in winter was 34° , the mean 58.65° and maximum 83° . Snow is only seen on the mountain tops in the northern part of the province. Frost and hail are very rarely seen. During the months of October to February, inclusive, but little rain falls, the average being 1.45 inches per month. During the spring months, the rainy season, the average rainfall was 4.76 inches per month. The sky is overcast during most of this period. The weather during the summer months is usually clear and dry, though the humidity may be excessive, especially preceding heavy tropical thunderstorms and destructive typhoons, which are accompanied with deluges of rain, the average per month being 10.29 inches.

The majority of the people are agriculturists, living in villages, for mutual protection. Wet cultivation of rice is practised in the delta. The people are poor, but self-respecting. Their diet is limited in variety, and frequently quantity, as a result of floods. Rice, greens, fish, and tea are the staples. Human manure is used as a fertilizer, and as a consequence a very large proportion of the population is infected with intestinal parasites. Living conditions are very unsanitary.

The knowledge of scientific medicine in China had been in a state of arrested development until its introduction by missionary physicians in 1835 when the Canton Hospital was founded by Dr. Peter Parker, a Yale graduate, who is said to have opened China at the point of the lancet.

Owing to ancestral worship, the Chinese do not approve of mutilation of the human body, and thus ignorance of human anatomy is profound. The chief reliance for diagnosis has been the fæces and pulse of the patient, and medicinal remedies are secured from the animal, vegetable, and mineral world. There are internists and externists. The foreign surgeon is

called an externist, the physician an internist. Such conditions as tumors, abscesses, and ulcers, come to the surgeon for treatment; also fractures, dislocations, and gangrene. The only procedures employed by the Chinese externist are counter-irritation, cauterization, pinching the skin and tissues, acupuncture, and the application of plasters. Although during the past eighty-five years more than two million Chinese have been treated at the Canton Hospital and its dispensaries, it is certain that only the minority of the people of Canton city avail themselves of the services of foreign practitioners, and most of these for conditions requiring surgical treatment. The women do not readily submit to examination by men, and thus only about 35 per cent. of the patients treated in the Canton Hospital are women.

During the past ten years 120,000 dispensary and 19,524 inpatients were treated in the Canton Hospital; 13,761 operations were performed upon inpatients. Ninety-eight per cent. of the patients were Chinese, 80 per cent. were residents in this province and 20 per cent. in fifteen other provinces; 35 per cent. of the inpatients came from the immediate neighborhood of Canton, and 65 per cent. from districts throughout the two provinces with a population of forty millions. About 30 per cent. of the inpatients are farmers, 17 per cent. soldiers, 13 per cent. housewives, 12 per cent. merchants, 10 per cent. laborers, 8 per cent. students, and the other 10 per cent. miscellaneous occupations.

Seventy-five per cent. of the inpatients treated in the Canton Hospital are from the laboring classes. The same percentage of cases are of a chronic nature, or seen at a late stage of the disease. The patients usually try out the native physicians first, who, as a rule, aggravate the condition by their treatment, and relieve the patients of their substance. They therefore come to the missionary hospital in poor condition, anæmic from intestinal parasites, and in a state of malnutrition. As pain is the chief factor in causing the patients to come to the hospital, the disease is frequently inoperable.

Large tumors of many varieties and different tissues are observed. Heredity does not seem to be a factor, nor does occupation. Coolies carry their loads by means of a pole laid across the shoulder, and although the subjacent tissues are thickened, malignancy but rarely develops. The laborers work early and late, exposed to sun, rain, heat, and cold. Ulcers of the legs are common, 542 having been treated during this period, but malignancy is a sequel that is but rarely seen. Syphilis is not common among the farming class. The Chinese marry young. The majority of the tumors seen are external.

The following data are based upon the records of the 13,761 operative procedures performed in the Canton Hospital during the past ten years, the greater number of which I was responsible for. My thanks are due to other members of the staff for the use of their records.

One thousand five hundred and sixty tumors were excised (12 per

TUMORS IN SOUTH CHINA

cent. of the total operations) ; 1090, or 70 per cent., were benign, and 470, or 30 per cent., malignant. There were 290 carcinomas and 180 sarcomas ; 60 were epitheliomata. Malignant growths seem to be about equally prevalent in males and females. Males are more inclined to sarcoma ; the average age was forty years. The average age of those treated for carcinoma was forty-four years. There were 105 papillomata, 134 sebaceous cysts, 69 lipomata, 54 fibromata, 51 keloids, and 9 myomata.

To the Chinese any abnormal swelling is a tumor. Among such conditions dealt with were 943 abscesses, 567 cases of osteomyelitis, 268 cases of lymphadenitis, 130 hydroceles, 55 herniæ, 33 aneurisms, and 30 carbuncles.

Bones and Joints.—Twenty-six cases of osteosarcoma of the femur, tibia, fibula, humerus, radius, inferior maxilla, superior maxilla, and pelvis, requiring excision or amputation. There were 9 osteomata, 6 enchondromata, and 4 chronic enlargements of the os calcis. Many cases of osteosclerosis, and a few of acromegaly, were seen. Case No. 14,569, male, aged thirty-five years, with symptoms dating for two years previous to admission, had myeloid sarcoma of the right knee, which was 32½ inches in circumference, the normal one being 12 inches. Case No. 19,344, a male, farmer, aged forty-nine years, with sarcoma of the inferior maxilla, large, hard, immovable, and cervical adenitis, growing for a year and a half. The common carotid artery was ligated, the half of the inferior maxilla resected and glands excised.

Circulatory System.—Thirteen angiomata were treated and one perithelioma of the carotid body excised. Case No. 191,683, male, aged fifty-six years, charcoal merchant, noticed a small tumor on his neck twenty years previous which commenced to enlarge rapidly two years ago. The tumor was the size of an egg, upper part hard, lower part firm, movable laterally (slightly) with lateral pulsation, no bruit. The tumor was found to be situated at the carotid fork, perforated by the carotid arteries, which were ligated, and the tumor dissected out. The larger arteries were ligated 132 times in 32 per cent. of the cases, the external carotid with no fatality ; and in 28 per cent. of the cases the common carotid with two deaths, one upon the operating table and one three days later.

Digestive System.—Mouth, jaw, etc., 8 ranulas, 15 tumors, 8 cancers of the lip and 4 of the tongue ; males, average age fifty-nine years. There was one sessile fibrosarcoma of the posterior pharynx of two years' duration, Case 14,867, male, farmer, aged twenty-seven years, had nostrils also filled with polypi, which were first snared. A preliminary tracheotomy was performed. The soft palate was split, and the tumor excised. Because of the hemorrhage it was necessary to pack the pharynx for twenty-four hours.

Abdomen and Wall.—Thirty-nine exploratory laparotomies were performed in which the tumors were found to be inoperable. There were 5 splenectomies, and 5 carcinoma of the stomach and 6 of the liver. The average age for the males was forty-one years and for

the females forty-five years. Case No. 141,438, a female, a farmer's wife aged twenty-nine years, had a cyst of the mesentery 5 inches in diameter which she had first noticed six months previous. Three cases of tubercular mesenteric glands were operated upon and eight cancers of the rectum, the average age being fifty years. There were several rectal polypi.

Genito-urinary System (170 buboes, average age twenty-eight years).—There were thirty-six cases of cancer of the penis, usually with a history of syphilis or gonorrhœa. The cases were advanced, ulcerated, with pain, hemorrhage, and inguinal adenitis. They were farmers, merchants, and laborers in this order of frequency. The ages ranged from twenty-nine to fifty-seven, average forty years. The duration of disease was given as from two months to three years, average one and one-half years. There were 11 orchidectomies for tumor, 6 malignant growths of the bladder, 6 hypertrophied prostates and 1 of malignancy, 6 cases of elephantiasis of the penis and scrotum, 2 varicoceles, and a few polyps and cysts. Case No. 191,959, male, aged sixty-five years, had complete retention for four days, greatly hypertrophied prostate, 155 small vesical calculi (total weight 14 grams), inguinal hernia, and double hydrocele. Case No. 161,380, male aged sixty-five years, farmer, had complete retention of urine for two days. He had been repeatedly catheterized outside and in addition to stricture had many false passages. He had in addition hypertrophied prostate, 8 small vesical calculi, double inguinal hernia, and hemorrhoids.

Lymphatic System, Ductless Glands, Etc.—Five parenchymatous and 1 exophthalmic goitres were operated upon. Four splenectomies were performed, and one splenic artery was ligated for splenomegaly. This is a common condition, but most of the cases are treated in the medical service. The disease is commoner in males, and the average age of those admitted to the hospital is thirty-one years. Several cases of malignancy of the pancreas were seen.

Seventy cases of carcinoma of the breast were operated upon, the radical operation being performed. Eighty-five per cent. were public ward patients, the ages ranging from twenty-one to seventy-four years, the average being forty-two; 95 per cent. were married women. The occupations were in order of frequency, farmers, housewives, laborers, and seamstresses. The left breast was affected in 64 per cent. and the right in 36 per cent. The duration of disease given was from four months to thirty years, the average being two and one-quarter years. In the case of the tumor of thirty years, the pain and adenitis had only been present for six months. The majority of the cases had axillary adenitis. In many cases Chinese medicine having been applied, the superficial tissues had broken down. Several recurrences were noted. Owing to conditions existing in China, it is very difficult to obtain end-results. Many inoperable cases are seen (Fig. 2).

Twenty-seven adenomata of the breast were removed. The ages of the patients ranged from thirty to seventy, the average being

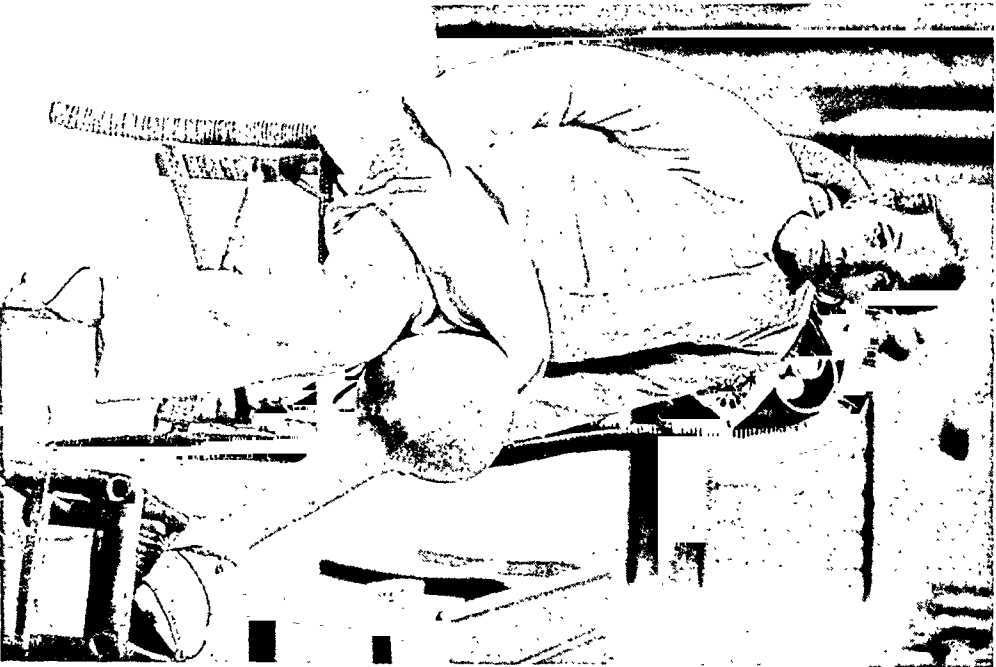


FIG. 1 (Case 14-1560).—Osteosarcoma of femur of twenty years' duration. Disarticulation at hip joint.

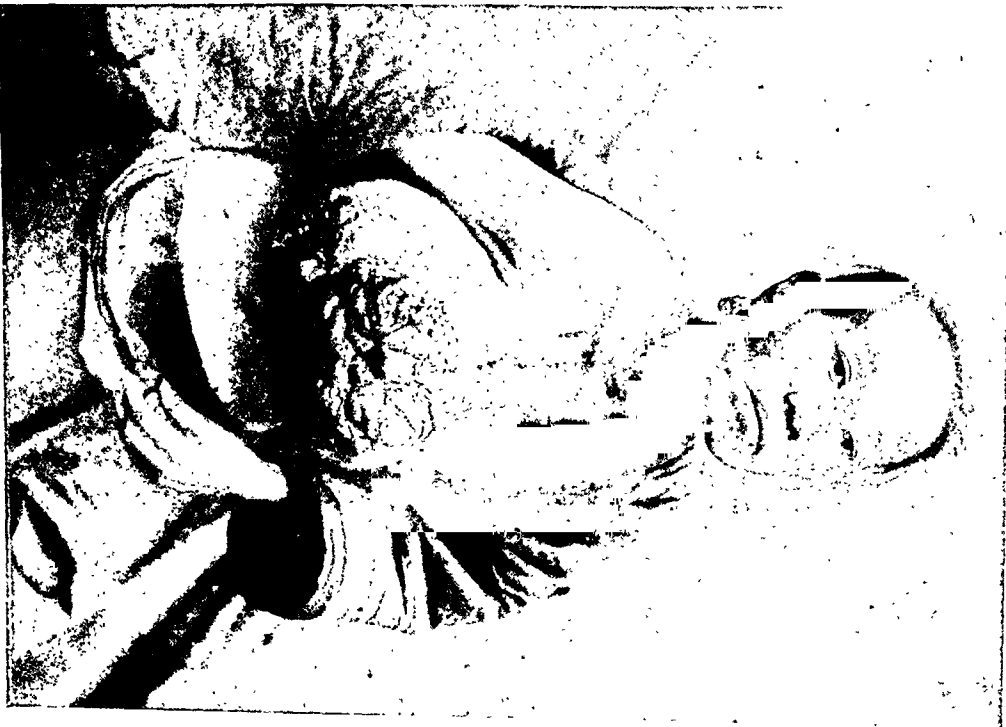


FIG. 2.—Patient with cancer of the breast.



FIG. 3.—Fibrosarcoma of the upper eyelid removed from patient 20-864 in the Canton Hospital.

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thirty-seven years. The average duration of disease was three years. One patient stated that her habit of scolding was the cause of the tumor.

Twelve mixed tumors of the parotid gland were excised. These tumors are usually large when seen.

Cervical adenitis, tubercular, 268 cases, 60 per cent. males, 40 per cent. females; aged six months to fifty-six years, average male twenty-two, female twenty; married, 35 per cent.; single, 65 per cent.; duration of disease twenty days to three years, average one year; 60 per cent. both sides of neck affected, 40 per cent. left side only; occupations in order of frequency, farmers, soldiers, merchants, students, and silkworkers. Many cases required ligation of the internal jugular vein in the block dissection. Many of the operations are rendered more difficult because of preliminary treatment by the Chinese quacks who apply strong plasters and counter-irritation producing dermatitis, adhesions, ulceration, scars, and keloids.

Seventy-one patients with lymphosarcoma were operated upon, 83 per cent. males and 17 per cent. females, 97 per cent. were married. The ages ranged from twenty-two to fifty-six years, average forty; 44 per cent. were double, 28 per cent. left, and 28 per cent. right side of the neck. The duration was two months to eight years, the average being one and one-half years. Occupations, 25 per cent. farmers, 12 per cent. merchants, the balance miscellaneous. In inoperable cases the supplying artery is frequently ligated, either the external carotid, if possible (without a fatality), or the common (with only two deaths). Frequently, as a consequence, the tumor becomes operable after a delay of a week or ten days. The hæmoglobin averaged 70 per cent. The chief symptoms were headache, pain in the neck and head, difficulty in swallowing, and loss of weight. Some had epistaxis, tinnitus, cough, and expectoration. Probably the majority of patients admitted to the hospital are affected with intestinal parasites.

Thirty-one cases of elephantiasis were dealt with, one of the face, one of the labia, and the rest equally divided between the leg and penis and scrotum. The ages were from fifteen to fifty-four years, average thirty-three; 75 per cent. were males. There were the same number of single as married. The duration of disease was from two and one-half to ten years, average five years. Occupation, farmers, 65 per cent.

Infections.—In addition to the bacteria and parasites already mentioned as the cause of abnormal swellings may be mentioned 21 cases of abscess of the liver due to the amœba; 30 carbuncles; psoas abscess is quite common, the average age of the patients with this condition being twenty-four years.

Nervous System.—Five neuromata were excised, including one tumor of the spinal cord.

Gynæcology.—There were 209 tumors of the female generative organs. Ovarian cystadenomata, 140; 82 per cent. were public ward patients; 4 died; 80 per cent. were married, and 20 per cent. single;

65 per cent. had borne children and 35 per cent. had not been pregnant. The ages ranged from twenty to fifty-two years, the average was thirty-one years upon admission to the hospital. The duration of disease was from three months to twenty years (as stated by patient), the average three years. The greater number were left-sided cysts. The occupations in order of frequency were farmers, silkworkers, and seamstresses. Hæmoglobin average, 74 per cent. The average abdominal girth was 47 inches, and weight of the tumors 40 pounds. Fifteen years was the average age at which menstruation commenced. One tumor weighed 116½ pounds, and the patient 79 pounds after the tumor had been removed. Among the complications met with were splenomegaly, multiple cysts, fibroid of uterus, tubercular peritonitis, salpingitis, insanity, ascites, pancreatitis, and retroverted uterus. There were unilocular, multilocular, and solid tumors in this order of frequency. Adhesions to the peritoneum, omentum, small bowel, large intestine (requiring colocolostomy), appendix, bladder, uterus, liver, etc., required to be separated.

There were 6 parovarian cysts, 4 dermoids of the ovary, 1 papilloma of the broad ligament, and 1 cancer of the broad ligament. Twenty-five patients with carcinoma of the uterus were operated upon. The ages were from thirty-eight to fifty years, the average being forty-five. All of the patients were married. They were housewives or farmers. The duration of disease was from five months to two years, average seven months.

There were 21 uterine fibroids. The largest weighed 20 pounds, the patient's abdominal girth being 35 inches. The ovaries were cystic also. The ages were from thirty-two to fifty years, the average being thirty-seven. The duration of disease was from three to twelve years, average six years. There were 5 cysts, 2 adenomata, and 3 cancers of the vulva, also 3 uterine polypi. In Case No. 161,374 the dermoid cyst contained masses of hair, eyelashes and three teeth.

Ophthalmology.—Forty-four chalazions, 4 gliomata, 4 mucocoeles, 3 cysts, and 10 miscellaneous tumors were excised (Fig. 3).

Otology, Rhinology, and Laryngology.—Ninety-three tonsils, 83 nasal polypi, 50 adenoids, 31 turbinectomies, 20 aural polypi, and 1 fibrosarcoma of the posterior nares were removed.

PSEUDO-POLYCYTHEMIA: EXTRAORDINARY BLOOD-CHANGES IN A PATIENT WITH RENAL CALCULUS

BY LEON HERMAN, M.D.

AND

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TRUE polycythemia is a well-established clinical entity with which our case has little, if anything, in common. We submit this report, not with the idea of adding to the data, already quite extensive, on the true polycythemic disease, but to place on record clinical and cytological evidence that remarkable functional disturbances sometimes occur in the hæmopoetic tissues in the absence of demonstrable organic changes in these tissues, in so far as the clinical demonstration of the latter is concerned.

We have received the following letter from Dr. Alfred Stengel, professor of medicine in the University of Pennsylvania, whose interest in the case we greatly appreciate: "Many thanks for the report of your remarkable case of polycythemia. I know of nothing in the literature that bears upon a polycythemia in connection with a kidney condition and disappearing when the kidney was removed; nor do I know of anything like the sudden flood of white-cells, mainly polymorphonuclears, such as occurred after the operation. The case was observed carefully, and although you have no explanation for the phenomena, its remarkable features warrant publication of the facts."

Mr. J. R., aged forty-nine years, a native of Spain and a chemist by occupation, presented himself for examination in 1914, when the following history was obtained. The patient had been a resident of Cuba from 1889 to 1906, and had served with the Spanish army during the Spanish-American War. During his active service with the army, he had contracted malaria which was insufficiently treated so that it lasted for many months. Two years prior to the malarial attack, he had suffered a severe burn with boiling oil. From this he recovered very promptly, and with the exception of certain accidental injuries and the condition for which he now consults us, he has been quite healthy. The first indication of kidney disease appeared in 1897, when he had what both he and his physician thought at the time was an attack of appendicitis. For several years prior to this he had been aware of the presence of an abnormality of the blood. Thus while assisting Dr. Domingo Madan of Matanzas, Cuba, in 1893, with the microscopical part of his researches on malaria, a blood-count was made "merely as a matter of curiosity," and it was found that his blood contained an unusually high proportion of red cells, the exact number of which he does not recall. He was in perfect health at the time and no attention was paid to the polycythemia.

There is little of further interest in the history until 1900 when he began to notice dull pains in the region of the appendix. About three weeks after the onset of these pains, he experienced his first attack of renal colic. This was soon followed by several very severe attacks after which he passed two small jagged stones. The pain was localized to the right side of the abdomen in each attack.

Following the passage of the stones he was without symptoms until 1914, when he presented himself complaining of indefinite pain in the upper right abdomen. After a thorough study including X-ray and cystoscopic examinations, the diagnosis of renal calculus was made and an operation was advised. The latter was postponed and the patient remained comparatively well until February, 1919, when after a violent attack of pain a third stone was passed. Ten days later he was again cystoscoped and the following facts were ascertained: Bladder mucosa normal except in the region of the right ureteral orifice: the latter is dilated and the surrounding mucosa is congested, contused, and oedematous. Urine from the right kidney is cloudy and contains a considerable amount of pus; that from the left kidney is normal. The urine from the right kidney was found to contain the colon bacillus in pure culture. The ureteral catheter meets with an obstruction in the region of the right ureteropelvic junction, but the flow of urine is apparently not interfered with. Indigo-carmin injected intravenously is eliminated from the left kidney in three minutes while only a faint trace of the dye is recovered from the right kidney during a half-hour period, the appearance time being eleven and one-half minutes.

Several days later a differential phthalein test gave the following results: The appearance time of the drug on the right side is seventeen minutes and only a faint trace of the dye is recovered: the excretion from the left kidney began in four minutes, and twenty-two and one-half per cent. is recovered during the first fifteen minutes of excretion.

The X-ray picture shows three shadows in the right kidney region, one large one, about the size of a plum, in the region of the pelvis, and two split-pea-sized ones in the location of the lower pole of the kidney.

The diagnosis of calculus with infected kidney was evident and the patient was sent to the Methodist Episcopal Hospital on March 10, 1919, for operation.

On the day following the patient's admission to the hospital, the resident physician reported a most remarkable condition of the blood; the erythrocytes were said to be 11,496,000 per cm., the hæmoglobin 115 to 120 per cent., the clotting time seven and one-half minutes, and the leucocytes 11,600 per cm.

Suspecting that some error in technic had been made, further examinations of the blood were made; this was done by taking specimens from both the finger-tip and the basilic vein on several occasions; the findings were, with very slight differences, the same as

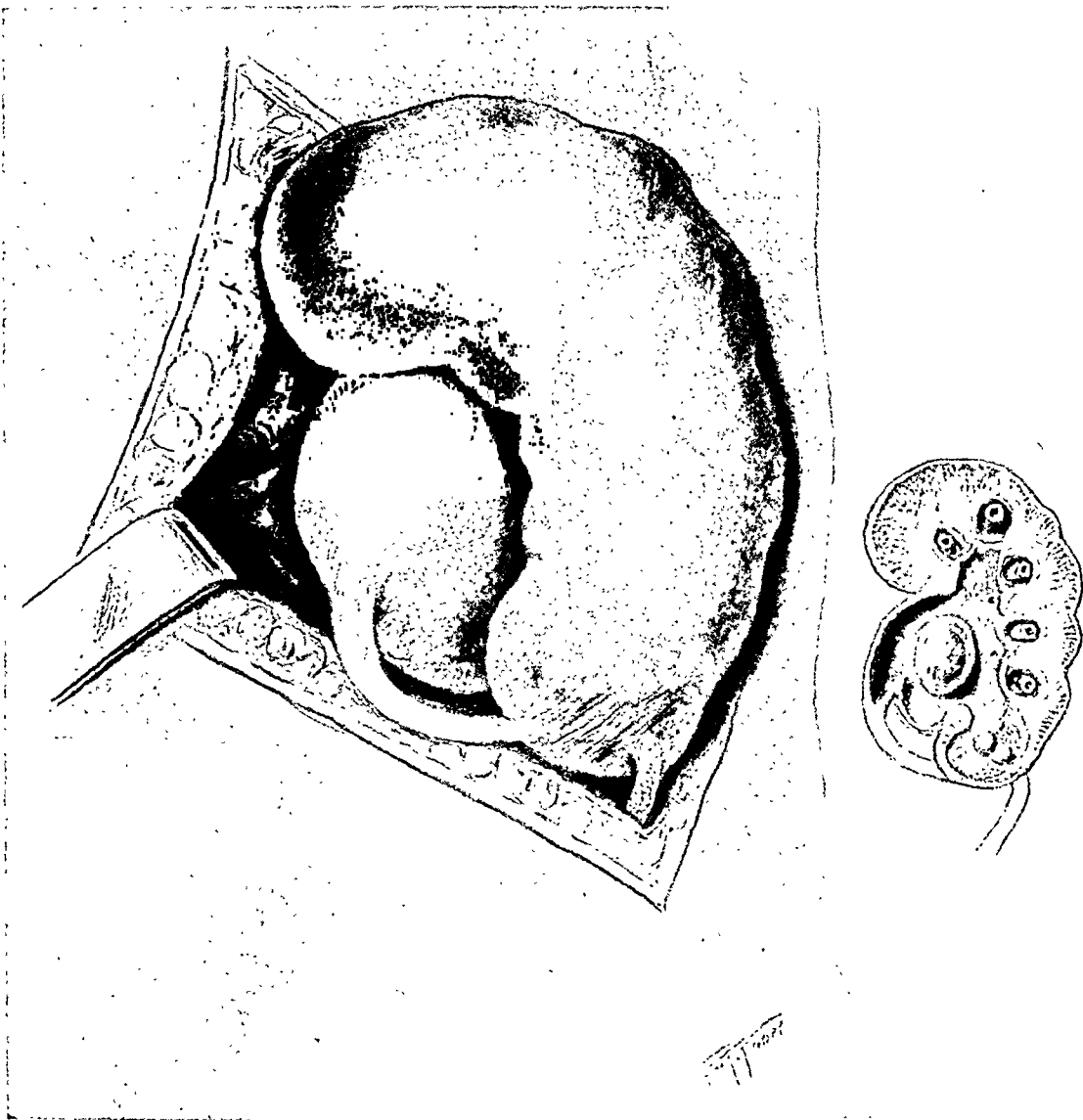


FIG. 1.—Hydronephrosis with calculi in a patient with pseudo-polycythemia. Note the perirenal adhesions attaching the ureter to the posterior surface of the lower pole of the kidney. The cause of these adhesions is found in a dilated and inflamed lower calyx which contains two small stones. The renal cortex at this point is very thin. The true pelvis is dilated and contains a larger stone.

those reported at the first examination. The later examinations were made by Dr. Russell Richardson.

We had considered the patient to be in excellent general physical condition, but in view of the unusual condition of the blood, he was again examined with the greatest care and we could find no evidence of cyanosis, enlargement of the spleen, or other signs of true polycythemia. We then searched for but failed to find any data concerning the significance of this type of polycythemia in kidney surgery, and after explaining the condition to the patient who insisted that the increased number of red cells would hasten the healing of the operative wound, we proceeded to remove the right kidney.

The kidney was exposed through an oblique incision under ether anæsthesia. It was found to be slightly ptosed and moderately enlarged. The extrarenal portion of the pelvis was dilated to about the size of a hen's egg and contained a rounded, plum-sized stone (Fig. 1). The organ was delivered after freeing a very few adhesions and the ureter was exposed several inches below the lower pole of the kidney and divided between clamps. On tracing the proximal segment of the ureter upward, it was found that the tube was densely adherent to the posterior surface of the lower pole of the kidney. Subsequent examination of the removed kidney showed that the ureter had been caught up in a mass of perirenal adhesions and had been drawn to the surface of the kidney to which it was adherent, thus producing a marked kinking of the tube.

The cause of the perirenal inflammation was found in a dilated and infected lower calyx which contained the two small stones shown in the X-ray plate. The cortex of the kidney at this point had become greatly thinned and transformed, for the most part, into fibrous tissue. The lumen of the ureter was somewhat constricted where it was adherent to the renal surface, but the obstruction found on attempting to pass the ureteral catheter was evidently due to kinking of the tube rather than to actual obliteration of its lumen.

Microscopic studies of the renal cortex showed more or less cloudy swelling and necrosis of the tubules. The majority of the glomeruli showed considerable congestion together with cellular proliferation, and some slight infiltration with small round-cells. There was very little increase in connective tissue throughout the organ; in fact, the degree of kidney destruction did not seem sufficient to explain the almost complete lack of function as measured by the functional tests. Loose connective tissue containing irregular bits of muscle-fibre were the characteristic features of sections taken from the upper ureter and dilated pelvis. A moderate infiltration with small round-cells was demonstrable throughout the specimen. There is evidently nothing peculiar in the condition of the kidney that could be associated etiologically with the polycythemic state of the blood.

Three days after the operation it was found that the hæmoglobin had become reduced to 108 per cent., together with a remarkable decrease of the red cells to 5,504,000; the leucocytes were 11,200.

The convalescence was proceeding without incident and we were astonished to find on March 27th, thirteen days after operation, that the blood contained the remarkable number of 260,000 leucocytes per cm. Doctor Richardson reported on the following day that the hæmoglobin was 90 per cent., the erythrocytes 4,480,000, and the leucocytes 242,000 per cm. The differential leucocyte count was as follows: Polymorphonuclears, 74 per cent.; small mononuclears, 13 per cent.; large lymphocytes, 4 per cent.; transitionals, 5 per cent.; acidophiles, 4 per cent.; and basophiles, 1 per cent.

The leucocyte count gradually diminished but with a relative increase in the number of polymorphonuclears.

The patient's condition was at all times excellent and the convalescence was entirely without incident. The highest temperature recorded was 99 degrees on the day of operation, and after this it never rose above 98. The systolic blood-pressure fell from 150 before operation to 126 several days after operation: the diastolic pressure fell from 90 to 86.

It was impossible to keep the patient quiet and against our advice he sat up in bed almost from the first and was sitting up in a chair eight days after operation. At this time he insisted upon going home, but this we would not permit.

On March 31st the blood examination showed 88 per cent. of hæmoglobin, 4,360,000 red cells, 22,800 white cells, and a differential leucocyte count as follows: Polymorphonuclears, 81 per cent.; lymphocytes, 16 per cent.; transitionals, 2 per cent.; and acidophiles, 1 per cent.

The patient was discharged from the hospital on April 1st and returned to his work a week later and has since remained well. One year after the operation Doctor Richardson examined the blood and found it to be normal. At no time during the course of these examinations were there any abnormalities in the size or shape of the red cells noted.

PERTROCHANTERIC FRACTURE OF THE FEMUR

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ACCORDING to Stimson ("A Practical Treatise on Fractures and Dislocations," Lea & Febiger, 1917, 394), this class (*i.e.*, Fractura Pertrochanterica, Kocher) may be defined as composed of those cases in which the line of fracture begins at or near the lower part of the junction of the neck and shaft and passes through or close below the great trochanter, dividing the bone into two parts, of which the upper is formed by the head, neck, and upper part of the trochanter. The line of fracture may be oblique from within, outward and upward, or from behind upward and forward. Such a case was encountered in the service of Professor G. P. Muller, at the Polyclinic Hospital.

This patient (Case No. 2508), a female, aged sixty-five years, was admitted on February 22, 1920, complaining of pain in the right hip and disability on flexion of thigh on abdomen. She stated that she fell on an icy pavement and was unable to get up. *She distinctly remembered falling backward.* She was immediately brought to the hospital.

Physical examination revealed tenderness along upper third of right thigh, most marked near neck. There was no gross deformity. There was some ecchymosis. The limb was so painful that no attempts to elicit crepitus were made. Pending X-ray examination the limb was put up in Buck's traction apparatus.

The skiagram (Fig. 1) revealed the plane of fracture oblique from within outward and upward, beginning several centimetres below the base of the great trochanter, at which point the separation is most marked in the picture.

The plane of fracture in this case somewhat resembles that in Kocher's first case, which is figured by Stimson (*loc. cit.*, Fig. 273, page 395) and corresponds to Stimson's description of his own case, in which the line of fracture was very long and oblique, extending from the top of the trochanter downward and inward.

The treatment in this case was based upon the location of the fracture, the absence of shortening and the presence of but trifling deformity. A plaster-of-Paris spica was applied, beginning at the toes and extending to the costal border. A skiagram taken on April 20th—two months after the injury—showed good alignment and good approximation. The patient was discharged, cured, on May 20, 1920—three months after the injury. At this time the fracture was soundly healed, as could have been forecast by a study of the skiagram, which shows broad surfaces of, for the most part, cancellous bone, with the promise of ample callus.

It was Kocher who first applied the term "pertrochanteric fracture" to this injury, which Stimson classifies under the heading "fractures through

the great trochanter and neck." The best and the most typical example of this fracture is the specimen in the U. S. Army Medical Museum, which is also figured by Stimson (*loc. cit.*, Figs. 275 and 276, page 396). That the plane of the fracture may vary from type, however, is understood by reference to the causative mechanism, which seems to be a cross-breaking strain acting upon the trochanteric region of the femur. In a recent paper on this fracture Wilensky (*Surg., Gynec. and Obstet.*, March, 1920, page 244) states that in all the reported cases the injury followed a fall, and that in all, except one case, the fall was directed backward. "It seems most probable that the injury results from a play of force in which an extraordinary overextension of the trunk at the hip-joint occurs in the dorsal direction with, and upon, the lower limb as a relatively fixed pivot; an enormous strain is transmitted through the unyielding Y ligament which, while incidentally aiding the muscles very powerfully in fixing the upper end of the bone, at the same time determines a line of greatest weakness and least resistance in the bone. In attempting to recover the balance the long flexor muscles of the thigh are very strongly contracted and a powerful stress is exerted across the length of the femur which has the tendency to bow the femur in a forward direction. A sufficient continuation of the indicated stress and strain results in a solution of continuity, and the latter must necessarily take place at the line of least resistance, determined by the Y ligament, which corresponds with the lowermost line of attachment of its fibres a little below the junction of the neck and shaft of the bone."

That this mechanism was effective is strongly suggested by the skiagram in my case (Fig. 1); my patient, too, fell over backward. The fracture, after all, is but a tear- or sprain-fracture on a large scale; indeed, in its mechanism, it reminds one of fracture of the patella due to indirect violence.

Wilensky was much impressed with the rapidity with which his fracture united and with the relatively large amount of callus which formed, and states that all these types have the valuable characteristic of healing promptly and efficiently.

An additional case of pertrochanteric fracture was recently reported by Wassink, of Amsterdam (*Surgery, Gynecology and Obstetrics*, December, 1920, p. 636).



Pertochanteric fracture of the femur. Arrows point to plane of fracture. The cross-breaking mechanism is suggested and prompt and efficient healing forecast.

MESENTERIC EMBOLISM IN A HÆMOPHILIAC*

BY FRANK BENTON BLOCK, M.D.

AND

SAMUEL GOLDBERG, M.D.

OF PHILADELPHIA, PA.

MESENTERIC embolism is hardly to be considered an extremely rare condition since over four hundred cases of this interesting and decidedly dangerous entity have been reported. However, there are such unusual features in the case about to be presented as to make it worthy of discussion. In the first place, a correct pre-operative diagnosis was made which, according to Trotter's Monograph ("Embolism and Thrombosis of the Mesenteric Vessels," Cambridge, 1913), was done in only 4 per cent. of 366 collected cases. Another unusual feature and of much more importance to the patient is the fact that recovery followed the operation. The mortality in these cases is high, varying from 80 to 94 per cent. in various reports of collected cases. Another feature of particular interest in the present case is that the patient was a true hæmophiliac, of which fact we were not aware until after the operation, when the continued uncontrollable oozing of blood from the wound caused us to question the family only to learn of the previous hæmophilic history. This decidedly treacherous complication almost cost the patient her life at a time when she was just beginning to show signs of recovery, and had it not been for a prompt and voluminous transfusion she probably would have joined the usual 90 per cent. of mortalities, through no fault in diagnosis or technic, rather than being happily in the less than 10 per cent. class of recoveries. Hæmophilia is fortunately rare, and we are told that although transmitted by the female to the male offspring, it is seldom manifested in the female. There, again, is another unusual feature of our case. Having thus prefaced our report and given, we hope, sufficient reason for appearing in print, we shall present the case as follows:

A female, married, aged forty-five years, was admitted to the Jewish Hospital on September 10, 1920. She complained of acute pain throughout her abdomen. On the day before admission, after the patient had lunch, she felt nauseated, and on the same evening she developed sudden severe abdominal pain which was cramp-like in character. The pain became aggravated and was associated with almost continuous vomiting. The vomitus consisted of a greenish material at times and at other times it was very foamy but had no characteristic odor nor did it contain blood. The bowels were constipated, although she had taken magnesium sulphate, and an enema

* Presented before the Philadelphia Pathological Society, October 14, 1920.

had been given. The previous history is of interest in that twenty-four years ago bleeding from the rectum was noticed for the first time. The patient states that this bleeding was quite profuse and continued intermittently for two years. It stopped for several years and then recurred. The last attack was five years ago and lasted about two years, weakening the patient so much that she could hardly walk. This bleeding was always unaccompanied by pain and the condition had been diagnosed as intestinal ulceration. In June, 1920, the patient noticed a lump on the left shoulder about the size of an egg, which became black and increased in size until it involved the left arm as far down as the elbow-joint and extended across the chest. All of the involved parts became black and it took about eight weeks for the discoloration to disappear. The menstrual history was negative. On physical examination, the patient appeared to be in intense agony. She was in the dorsal position with the thighs flexed on the abdomen and any attempt to extend the thighs increased her pain. The abdomen was not rigid, but there seemed to be a moderate amount of tenderness in the lower left quadrant, but the pain, while more severe in this region, was general. No mass was palpable nor was there any noticeable distention. The peristaltic movements were well heard. Her temperature was normal, the pulse was 110 and there was no increase in the respiratory rate. The heart sounds were well heard and seemed to be normal except for a slight roughening of the first sound at the aortic area. There was no evidence of valvular vegetations. Throughout the examination the patient had persistent vomiting spells. From the foregoing facts there appeared to be no doubt in our minds that the patient was suffering from an acute intestinal obstruction, and from the acuteness of onset and violence of symptoms, together with the reference of pain toward the left lower quadrant, a diagnosis was made of either mesenteric embolism or volvulus of the sigmoid and immediate operation was advised. On opening the abdomen there was a gush of blood-stained fluid followed by the prolapse of a moderately distended intestine into the wound. On passing the hand down to the left lower quadrant a firm mass was felt which proved to be an intensely congested ileum which was on the verge of undergoing gangrene. The mesentery of this portion of the gut presented a beautiful picture of infarction. The involved area of gut was about 6 inches in length, the intestines below the diseased area appeared quite normal, while the bowel above showed graduated degrees of congestion, most marked, of course, as it approached the infarcted area. The diagnosis was by this time perfectly clear, and the patient's condition being fairly satisfactory a resection was decided upon. The diseased loop, together with several inches of the congested gut above the infarct and the accompanying mesentery, was removed. The open ends of the gut above and below the resection were inverted and closed and a lateral anastomosis was made and the operation

completed by tacking the omentum of the side of the anastomosis. The abdomen was closed without drainage. While closing the superficial tissues it was noticed that there was a slow but continuous oozing of blood, the origin of which could not be determined, and for this reason the patient was given an injection of normal horse serum on the table and the wound was closed particularly carefully, and firm pressure was made against it from without. Despite these precautions the oozing continued for twenty-four hours, and having tried all the usual local hæmostatics without success a transfusion was performed by the "Citrate Method," the patient receiving about twenty ounces of blood. Almost immediately the bleeding stopped, and aside from a well-marked reaction due to the transfusion the patient's condition became markedly improved. For the next few days she ran an irregular fever, followed by the development of a hæmatoma in the lower end of her wound which was not disturbed. Her temperature then became normal and in the course of about a week the wound expelled the hæmatoma and closed by granulation. Three weeks after the operation the patient was out of bed and went home shortly thereafter in good condition, and when last heard from was in perfect health.

Although the literature has been rather thoroughly studied by us we shall not review it in this report, but refer those interested to the papers of Jackson, Porter and Quinby (*Journal A. M. A.*, 1904, xliii, 43) and Eisenberg and Schlink (*Surgery, Gynecology and Obstetrics*, 1918, xxvii, 66), both of which contain excellent digests of the previous literature and reported cases. Several papers have been presented since these two, most of them reporting a single case ending in death. Exceptions may be noted in a series of six cases reported by Ross (*ANNALS OF SURGERY*, 1920, lxxii, 121) one of which recovered. Whether our case was one of arterial or venous obstruction we cannot positively state, inasmuch as hemorrhagic infarction occurs in both conditions. Furthermore, while we believe the condition was arterial we can only state that it was an embolism rather than a thrombosis, chiefly by the acute onset of symptoms. We agree with Eisenberg and Schlink (*loc. cit.*) that all of these pathological terms should be grouped together for clinical purposes under the term "mesenteric vascular occlusion."

The etiology of this condition is variable, as is the etiology of thrombosis and embolism elsewhere, but we believe that our case could hardly have been a thrombosis, inasmuch as the patient had not sufficient clotting power in her blood to cause normal coagulation, much less the abnormal coagulation of a thrombosis. However, there may be some relation between hæmophilia and thrombosis that we have not as yet learned. Another question worthy of conjecture is whether the intestinal hemorrhages from which the patient suffered in the past were due to her hæmophilic constitution or to a manifestation of another mesenteric

embolism, which finally cured itself, as in a case of Deaver's reported by Ross.

We have learned several important points in having treated this case, namely: (1) Sudden and *persistent* vomiting without apparent cause associated with *recurrent, severe* abdominal cramps should call for early abdominal exploration. (2) If the patient is in reasonably good condition, wide resection of the infarcted area with lateral anastomosis is the operation of choice. (3) Hæmophilic manifestations should be combated at the earliest moment by transfusion of at least 500 c.c. normal blood. No time should be wasted on horse serum, thromboplastin, etc., if results are not obtained within one hour or two.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting held October 27, 1920

The President, DR. WILLIAM A. DOWNES, in the Chair

RESECTION OF RIGHT SIDE OF COLON WITH MESENTERIC GLANDS FOR PAPILLARY ADENOCARCINOMA OF CÆCUM (THREE AND ONE-HALF YEARS POSTOPERATIVE)

DR. NATHAN W. GREEN presented a woman, aged thirty years, who was admitted to St. Luke's Hospital on August 19, 1916, for relief of a chronic left-sided salpingo-oöphoritis and subacute appendicitis.

On August 21, 1916, the left tube and the appendix were removed by Doctor Green. The appendix was 7 cm. long, much swollen and somewhat distorted, measuring from 1 to 1½ cm. in diameter. The Fallopian tube showed a lumen filled with granulation tissue on which were scattered epithelioid tubercles, some of which contained typical giant-cells. No tubercles were seen in the appendix or ovary (Dr. F. C. Wood). The ovary contained some gelatinous cysts. She was discharged cured on September 8, 1916.

On October 13, 1916, she was readmitted with a diagnosis of tuberculous salpingitis of the right side, having been well until one week before admission, and on October 17, 1916, the right tube, ovary, and the uterus were removed under Dr. Walton Martin's direction by Doctor Venable, then house surgeon. The pathological report was again tuberculous salpingitis and tuberculous endometritis, fibrous uterus and chronic oöphoritis. On November 11, 1916, she was again discharged cured.

On January 13, 1917, she was again admitted with symptoms of incomplete intestinal obstruction with the history that since being last discharged she had not been well and had had a great deal of abdominal pain in the right side. She had a poor appetite and was constipated and had lost weight. On physical examination she had a soft abdomen without muscular spasm. In the right lower quadrant was definite tenderness and a soft tender mass was felt on palpation. Pelvic examination showed this mass to be above the brim of the pelvis. It was soft, tender, and rather freely movable. On January 20, 1917, an exploratory laparotomy and ileosigmoidostomy was done by Doctor Green.

Pathological Findings.—The uterus, tubes, and ovaries had been ablated. There were numerous bands and veils of adhesions about the abdominal

cavity, most numerous about the large gut. No distinct constriction of the gut could be found. *The longitudinal bands of the ascending and transverse colon were hypertrophied, while those of the descending colon were not.* The appendix was absent, having been removed. The wall of the cæcum was thickened and surrounded by adhesions. A large cauliflower-like polypoid tumor could be felt on the interior of the cæcum, the ileo-cæcal opening was patent.

Operative Procedure.—The abdominal cavity was explored through a right rectus incision, excising the old scar. A side-to-side anastomosis was made between the lower end of the ileum and the sigmoid. This presented the easiest procedure and was made use of as the patient was not in good condition.

On February 6, 1917, she was discharged improved, seventeen days after operation. There were no symptoms of intestinal obstruction and she was sent to a convalescent home to return when her general state should be improved.

April 15, 1917, she was readmitted with the following interval history. After leaving St. Luke's Hospital she went to the country for two months and improved greatly; gaining in weight and feeling better. Two weeks previous to the last readmission the patient began to have severe cramping pain in lower right side, with vomiting. These attacks were repeated. There was no fever and bowels moved somewhat daily. Since the onset of these symptoms she had noticed a hard tumor in the right lower quadrant.

On April 18, 1917, an operation for resection of lower ileum, cæcum, ascending and part of transverse colon was performed by Doctor Green under gas and ether anæsthesia.

Pathological Findings.—Numerous rather firm adhesions between intestines and anterior abdominal wall. The cæcum was surrounded by a network of firm stringy adhesions which completely enveloped it. The cæcum was also quite mobile. The ileosigmoidostomy which had been done at a previous operation was found to be in good condition and well open, admitting the tips of three fingers. The cæcum contained a rather large, firm, apparently pedunculated, freely movable tumor about the size of a lemon. The glands of the mesentery supplying the cæcum were enlarged, several being 3 cm. in diameter.

Operative Procedure.—An incision was made along the site of former operation (right rectus). Adhesions to anterior abdominal wall were divided and ligated. The cæcum was mobilized by dividing adhesions and ligating whenever bleeding occurred. The mesentery of the transverse colon was pierced at about its middle and the mesentery of the ileum was pierced slightly below the anastomosis. Strong intestinal clamps crushed the transverse colon and ileum at points selected for resection. The mesentery of the cæcum, ascending and transverse colon to right of the colica media artery, and also of the lower ileum was ligated

RESECTION OF RIGHT SIDE OF COLON

and divided in stages, thus completely freeing this part of the intestinal tract to be resected. Double ligatures of number one chromic gut were placed around the ileum at the point crushed with the clamp, and securely ligated; a purse-string of number one chromic gut was placed around the ileum below the ligature. The ileum was then divided with the actual cautery distal to ligature. The stump of the ileum was then inverted under the purse-string suture and two reinforcing number one chromic gut sutures still further secured the site of inversion. The

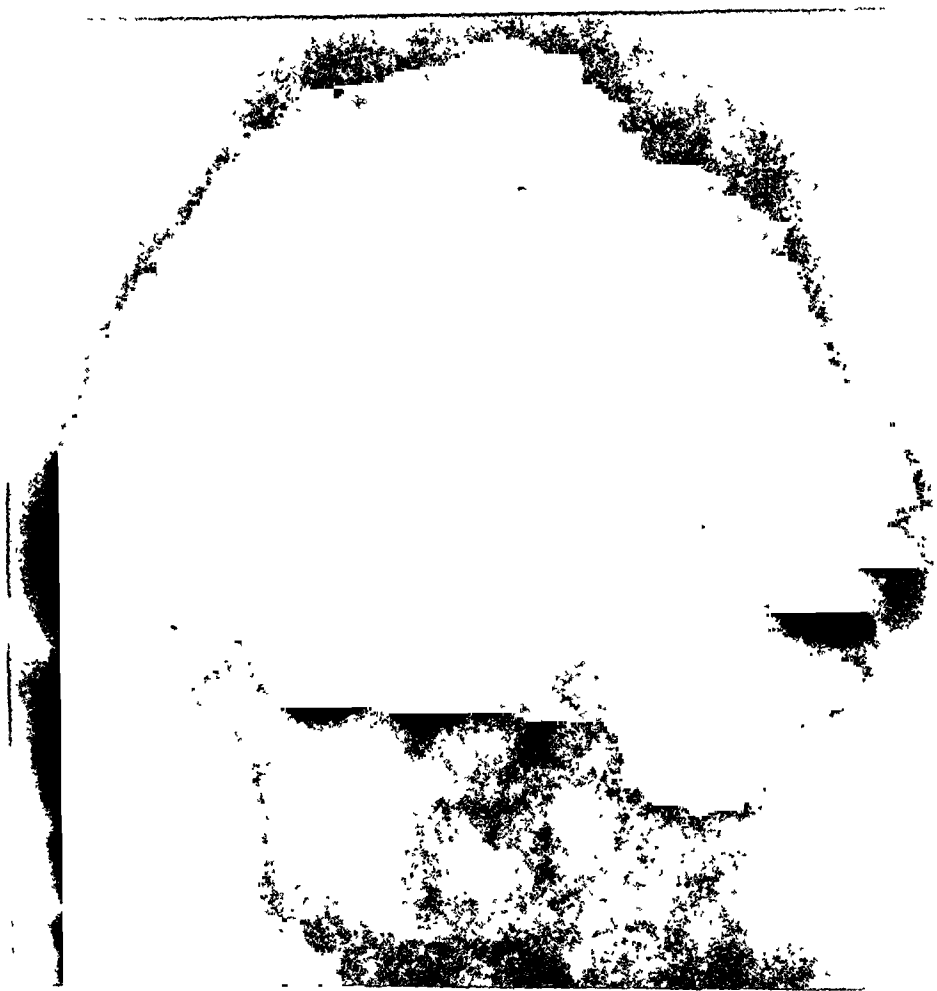


FIG. 1.—Right-sided colectomy for papillary adenocarcinoma of the cæcal juncture. Plate taken October 22, 1919.

transverse colon was similarly crushed and ligated at the point selected for resection. The stump was treated in the same way as the ileum. The enlarged glands in the mesentery were then dissected out and removed. All bleeding points were carefully ligated. The stump of the transverse colon was pulled into the upper angle of the incision in case of leakage. The wound was closed in layers with additional retention sutures of silkworm gut. There was no drainage. The patient was discharged cured on May 8, 1917, twenty days after the operation, and has been well since.

Pathological Report.—By Dr. F. C. Wood. Papillary adenocarcinoma

of cæcum. Inflammatory reaction in mesenteric lymph-nodes. (The lymph-nodes show an excess of fibrous tissue. The round-cells are rather few in number.)

This case is presented because of the coincidence of tuberculosis and carcinoma in the lower abdomen. Also to show the relatively non-malignant form of carcinoma which occurs in the cæcum. Also further to show that numerous and enlarged mesenteric glands need not necessarily be a contraindication to attacking surgically a carcinoma situated in the caput coli. A further point of interest is brought out by Dr. L. T. LeWald's röntgenogram, *viz.*, that the blind pouch of the remaining colon has not become overdistended.

The patient has been in the medical ward of the hospital this summer for a pyelitis following the drinking of a glass of lysol by mistake for some other liquid. She is now entirely well.

DR. DE WITT STETTEN corroborated what Doctor Green had said regarding the fact that enlarged mesenteric glands were no contraindication to a radical operation. He said that one and a half years ago he had resected a carcinoma of the splenic flexure, in which the mesenteric lymph-nodes were so enlarged that he felt that the operation was practically hopeless. Many of the glands were as large as hazel-nuts and some were even larger. The involvement in this case was so extensive that he was on the point of doing a palliative colocolostomy. Nevertheless, he did perform a radical operation, excising a large V-shaped section of the mesentery. The patient to date has gained over thirty pounds and up to the present is apparently entirely free from recurrence. Pathological examination of the glands showed merely inflammatory changes and no evidence of cancerous deposits.

RESECTION OF THE UPPER PART OF THE HUMERUS, THE OUTER END OF THE CLAVICLE AND THE HEAD OF THE SCAPULA FOR MEDULLARY SARCOMA

DR. N. W. GREEN presented a man operated upon three and one-half years ago. Before coming under Doctor Green's observation the man had been healed by the X-ray, and apparently the treatment had inhibited the progress of the malignant growth for a while. However, there was an extensive dermal traumatism which did not heal. The man was admitted to the City Hospital suffering great tortures, and it was thought the arm would have to be amputated. The patient, however, begged that the arm be saved, and so an extensive resection involving the outer end of the clavicle, the head of the scapula, and 4 inches of the humerus (Fig. 2) was done, and a plaster case was applied. The wound did not heal readily, particularly the part that was traumatized by the Röntgen therapy, because in resecting one had not kept far enough away from the scar tissue; but eventually it had healed up.

RESECTION OF UPPER PART OF HUMERUS

The pathological examination was made by Doctor Larkin at the Strecker Memorial Laboratory, and showed a small spindle-celled sarcoma (Fig. 3). For a long time crusts persisted at the end of the clavicle and over the clavicle, and a little over the shoulder. There was still some telangiectasis apparent, due to the Röntgen burn.

Doctor Green said he had hoped to obtain a result that would enable



FIG. 2.—Gross specimen, resection head of humerus, outer end of clavicle and head of scapula.

the man to feed himself, but there was now complete bony ankylosis between the scapula and the humerus.

The interesting point was the way in which the Röntgen treatment had affected the skin and muscles and had apparently limited the growth of the sarcoma. The muscle-fibres were as silvery as the scales of a fish. On cutting the bone, it was found filled with spindle-celled sarcoma.

The patient is now well and able to do a little work about his place in the country.

DR. ROYAL WHITMAN said that the brace evidently increased the de-

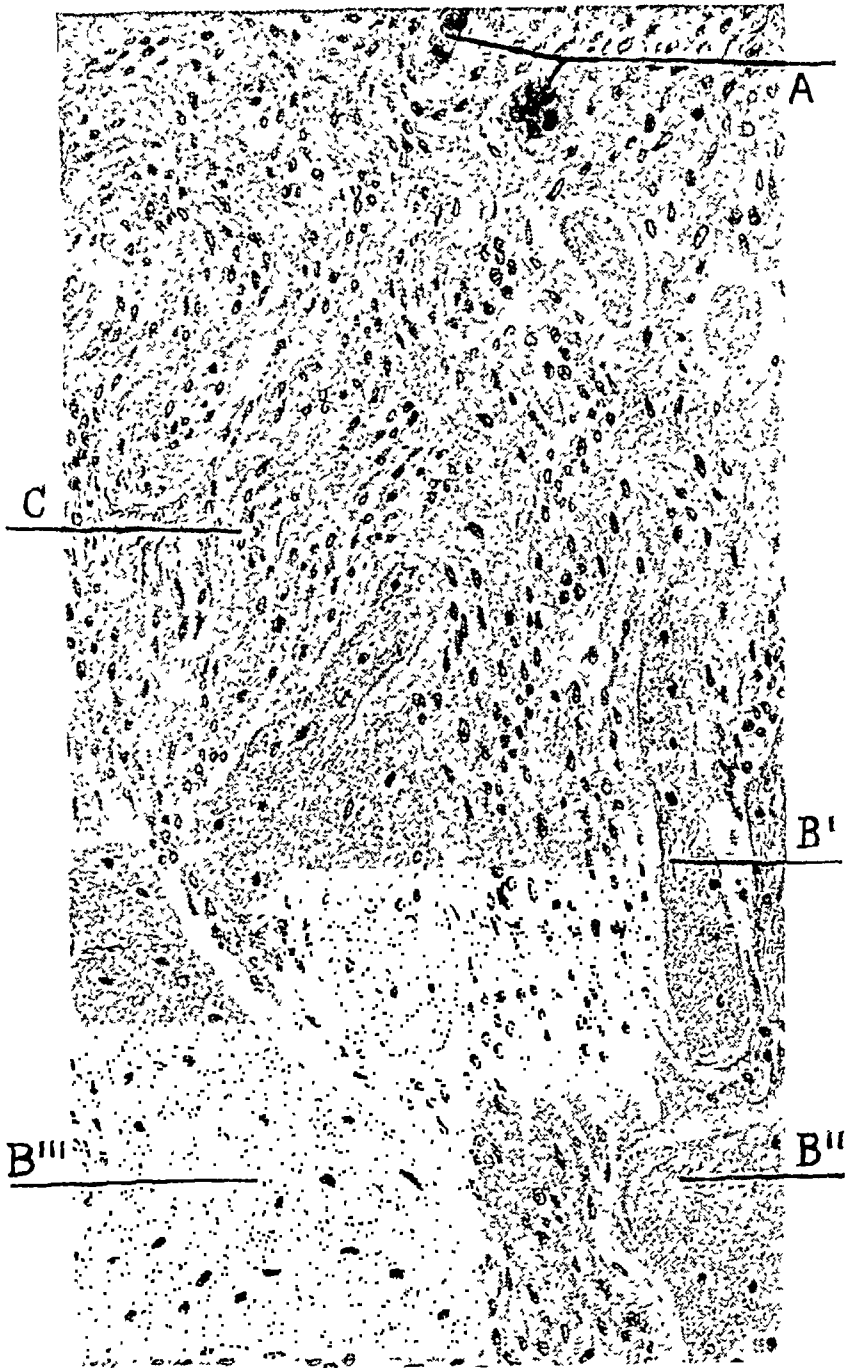


FIG. 3.—Microphotograph of section of head of humerus (Dr. Larkin).

formity. If it were removed the rotation of the scapula would permit the arm to be lowered as in the cases of paralysis in which the humerus had been intentionally fixed to the scapula in the same relation.

INFILTRATING CARCINOMA OF THE BLADDER

INFILTRATING CARCINOMA OF THE BLADDER

DR. EDWIN BEER presented this patient to call attention to the fact that it was just possible that a preliminary radiation of malignant tumors might aid the surgical procedure in obtaining curative effects.

This man, now sixty-two years of age, began to have typical symptoms of tumor of the bladder, hæmaturia, frequency and later pain about two years ago. The cystoscopic diagnosis made by another surgeon was papillary carcinoma. The patient was treated with cross-fire X-ray through the abdomen and radium through the rectum for many weeks. He finally stopped treatment, as in addition to the pains in the bladder he now had severe pains in the rectum. When the patient was first seen by Doctor Beer about eleven months ago, he had a large ulcerating papillary tumor of the left lateral and the posterior walls, which was easily palpable through the rectum as a mass the size of an orange. Owing to the extent of the growth the question of total cystectomy had to be considered. The operation to be described in the paper of the evening was done on the patient more than ten months ago. The tissues were found baked together so that dissection was unusually difficult. The perivesical fat and adjacent iliac glands were removed with about two-thirds of the bladder, so that when the organ was repaired it was the size of a sickle pear. The microscopic examination of the gland did not show malignancy. The bladder growth was an ulcerating infiltrating carcinoma of huge size, but fortunately did not involve the ureters, though it came to within about 1 cm. of the left ureter. The patient made an excellent though slow recovery. His bladder capacity gradually developed so that now his frequency is one to two hours by day and three times at night. He appears to be in excellent health and no signs of recurrence manifest themselves as yet.

From a rather extensive experience in this field, Doctor Beer felt certain that there would be a speedy recurrence of the growth in this patient. In view of the course of events, which were so unusual, Doctor Beer believed that the preliminary radiation might have done much towards this good result, and it was with this in mind that he asked the patient to present himself to-night.

DOCTOR GREEN said that he appreciated the efforts Doctor Beer had made to avoid the implantation of cancer cells. Doctor Green recalled that five years ago he had shown a case of gelatinous carcinoma of the bladder, in which the carcinoma was very large and involved the fundus. Doctor Bugbee did the cystoscopic examination on this case. Doctor Green then performed a partial cystectomy. Three years later in the scar below the umbilicus a small hard nodule appeared. It was discrete, but he concluded that it was a recurrence of the cancer from implantation and excised it. The recurrence was the same type as the original—rather

non-infiltrating. It was now two and one-half years since that had occurred and five and one-half years since the first operation. However, it must be remembered that cancers differed greatly from one another in malignancy. This carcinoma was doubtless not as malignant as the one in Doctor Beer's case, which had eroded a large-sized hole and formed a diverticulum in the bladder.

DR. JOSEPH WIENER said that Doctor Beer had operated upon him for a papilloma and he thought it might be interesting to the members of the Society to hear the inside history. Judging from the impression Doctor Beer gave him, he had an idea this was a major operation and he rather dreaded it. The post-operative disturbance was practically nothing. He awoke three hours after the operation with no nausea, vomiting or wound pain. For about three days he suffered very severe bladder spasms, not controlled by morphine at all. These spasms came on at almost hourly intervals for the three days. When the suprapubic tube was removed and Doctor Beer's cup applied, there was practically no leakage, and the patient was perfectly dry most of the time. Another advantage that this cup had was that instead of being open only at the lower part so that the patient had to lie on his back, this one was open at both sides, so that the patient could lie on either side without there being any leakage. Doctor Wiener said he remained in the hospital only nine days when he left for his out-of-town home, contrary to advice, and his recovery from that time was very rapid. He had taken out the stitches himself. There was some pain when he first voided, and the bladder spasm was very painful, but from the time the suprapubic tube was removed he had taken no drugs. A suprapubic fistula remained which took forty-two days to entirely heal.

DOCTOR BEER said that most men saw but few of these cases and that the results of the casual operator were far from attractive. In going over the results that had been published in tumors of the bladder it was most astonishing to see how frequently even benign growths recurred after operation. Naturally with malign tumors the results were even worse. Up to ten years ago some writers of experience recommended hands off in all bladder neoplasms. Though one could and did obtain an occasional cure of bladder tumors without using the technic described in this paper, if one followed this technic one would be surprised to see how frequently, almost regularly, in the benign papillomata, in the papillomatoses, and in the papillary carcinomata one avoided recurrences. For the infiltrating growths one could not say as much.

The technic described to-night was a gradual evolution, and had been in use for six years, during which time Doctor Beer and his associates operated upon some thirty-eight cases, all unsuited for one reason or other to the high frequency cauterization method. During the past few months there were three cases in which this technic could not be employed, and his experience in these three cases contrasted so vividly with his experience when he adhered carefully to the technic outlined, all

MULTIPLE DIVERTICULA OF THE UPPER ILEUM

three cases having rapid recurrences either in the bladder incision or in the wound, that he felt sure he was working along the correct line when he emphasized the importance of doing everything to avoid implants.

While talking of this matter, one case of papillomatosis, the result of wide dissemination of papilloma by the previous operator, came to Doctor Beer's mind. Eight such cases had been treated by this technic, most of them having innumerable tumors in the bladder, following an attempt at surgical cure. The case referred to above had just been reexamined some three years after the operation by Doctor Beer and the bladder found absolutely normal. This was an excellent test of the cautery, etc., technic described as the patient had had four previous operations in this country and abroad for papillomata of the bladder. Invariably the growths recurred rapidly, *i.e.*, implants were strewn over the bladder and when he was last operated upon the bladder was well filled with innumerable papillomata. By using the described technic in this and the other cases it was gratifying to see how almost regularly implants and therefore recurrences were obviated.

One must not be afraid to use the cautery thoroughly, and one must have an excellent exposure so that the cautery could get at every suspicious spot. Despite an hour's use of the cautery (Paquelin) (which with the electric cautery is never necessary), the patients did not suffer any more than the ordinary cystostomy cases.

In closing, Doctor Beer again emphasized that he believed the technic described in detail in his paper was going to mean a great deal to all those patients who for one reason or other could not be treated transurethraly with the high frequency cauterization method, *i.e.*, (1) Papillomatosis cases. (2) Intolerant to cystoscopy cases. (3) Tumors at the neck or elsewhere that bleed enough to embarrass the cystoscopist. (4) Inaccessible tumors. (5) Papillary carcinomata. (6) Infiltrating carcinomata.

MULTIPLE DIVERTICULA OF THE UPPER ILEUM

DR. DE WITT STETTEN presented a well-nourished man aged thirty-eight years, who had been complaining for several months of rather frequent, acute attacks of severe abdominal pain. These attacks were referred vaguely to the upper abdomen, were accompanied by gastric distress and nausea, and lasted for several hours. During the attack, the upper abdomen was slightly sensitive to pressure, but no definite localization could be determined. After the attack had subsided, the patient felt perfectly well. Proper attention to the bowels, a rigid diet, and alkalies seemed to have no effect in preventing a recurrence of the attacks. Examination of the abdomen in the intervals between the attacks revealed nothing but a moderate-sized umbilical hernia. The attacks suggested biliary colic, and a careful radiographic study of the gall-bladder region and gastro-intestinal tract was made by Dr. L. G. Cole. The gall-bladder region, stomach, pylorus, and duodenum were negative. An

unusually long, tortuous, and segmented appendix with retention ninety-two hours after the enema was demonstrated. Throughout the entire colon, especially in the descending colon and sigmoid flexure, numerous diverticula of varying size could be recognized. In addition to these, there were seen two large, almost spherical pockets of barium about $1\frac{1}{2}$ inches in their longest diameter. One was slightly smaller and more ovoid than the other. They appeared almost immediately after the ingestion of the meal and were still quite filled after seventy hours, even after



FIG. 4.—Radiograph twenty-eight hours after meal and after catharsis and ten minutes after enema and before evacuation. Shows two large diverticula of the upper ileum and multiple diverticula of the colon.

the administration of a cathartic. The larger was still fairly full one hundred and twenty hours after the meal. These pockets moved around to various parts of the abdomen and also in relation to each other, the smaller, however, always appearing below and to the right of the larger (Figs. 4 and 5). They were evidently sacculations connected with the small intestine.

On December 9, 1919, the speaker performed an exploratory laparotomy. The umbilical hernia was excised and the appendix removed. The gall-bladder was examined and found to be normal and free from

MULTIPLE DIVERTICULA OF THE UPPER ILEUM

calculi. Multiple diverticula of the colon were seen, but they were not inflamed, and therefore were not disturbed. Near the upper end of the ileum were found the two large pouches, some twenty inches apart, corresponding in size to the X-ray shadows. The lower one was somewhat larger than the upper. They seemed decidedly injected. Both were on the same side of the gut, at the mesenteric border, rather sessile, and dissecting under the one leaf of the mesentery. The mesenteric leaf was split, and the pouch, in each instance, was freed and ligated at its

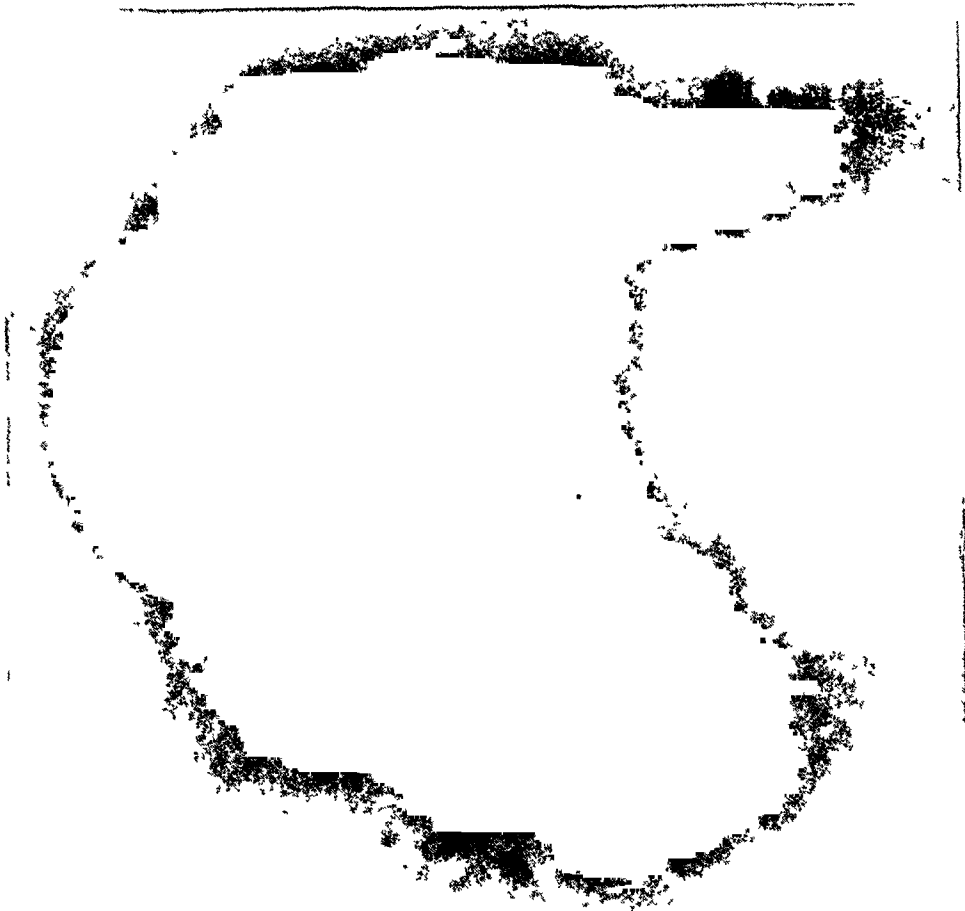


FIG 5 —Radiograph forty seven hours after meal and nineteen hours after enema. The two large diverticula of the upper ileum are still filled and are lying in juxtaposition. The long, tortuous and segmented appendix is also still filled and visible. Numerous diverticula of the colon can, likewise, be demonstrated.

junction with the intestine. After amputation with the cautery, the stump was buried by a purse-string suture of silk. The abdomen was closed in the usual manner. The patient had an uneventful convalescence and has been entirely free from any abdominal symptoms since the operation.

The diverticula were quite similar in their structure to the false or mucous membrane diverticula found elsewhere in the gastro-intestinal tract, namely, herniæ through the muscular coat. Judging from the extreme degree of retention, as demonstrated by the radiographic study,

their injected appearance at operation, and the complete freedom from symptoms since their removal, Doctor Stetten said he felt we were justified in assuming that they were the true cause of the acute abdominal attacks, probably manifestations of inflammatory or mechanical disturbances, resulting from the retention of intestinal contents. It was conceivable that these pouches might have led to much more serious trouble had they not been extirpated.

DR. JOHN F. ERDMANN said that while diverticula of the small intestine were quite rare as compared with the frequency of this condition in the large intestine, he had seen quite a number of diverticula of the small intestine. He had just recently removed a diverticulum from the junction of the ileum and cæcum. He had had two cases of the cæcum within the last four or five years in which the diverticulum had become gangrenous.

DOCTOR DOWNES mentioned that he had operated on a diverticulum in the hepatic flexure. At the operation he found three diverticula in the ascending colon, but none in any other part of the intestine.

DR. PARKER SYMS cited the case of a patient in whom gall-bladder trouble was suspected and an extensive examination made for gall-stones. In the course of the X-ray examination a diverticulum was shown in the neighborhood of the hepatic flexure. The filling up of the diverticulum with barium relieved the symptoms, so the patient continued to treat himself along this line.

DOCTOR STETTEN said that these diverticula were the typical false or mucous membrane diverticula in which the mucous membrane and submucosa came through the muscular coat. The diagnosis reached before operation was diverticula of the upper part of the small intestine. This was as accurate as one could be. As the sacs filled almost immediately after the barium meal it was obvious that they were high up in the intestinal tract. Doctor Cole, who made the X-ray examination, was actually quite thrilled when he saw the plates. Of course, he had seen many cases of diverticula of the colon, and also of the duodenum, but this was the first time in his extensive experience in gastro-intestinal radiography that he had been able to demonstrate radiographically a diverticulum of the jejunum or ileum.

Stated Meeting held November 10, 1920

The President, DR. WILLIAM A. DOWNES, in the Chair

BONE GRAFT OF HUMERUS FOR NON-UNION

DR. FRANZ TOREK presented a man who fractured his humerus nineteen and one-half years ago. Wiring of the fragments was resorted to without benefit. Unable to use the arm. On January 15, 1920, he came under Doctor Torek's treatment at the Lenox Hill Hospital, requesting that his arm be amputated rather than that he should again undergo prolonged treatment which he felt sure would be futile.

OPERATION FOR UNUNITED FRACTURE

The right arm presented an extreme angular deformity near the middle where a false joint existed. The muscles were atrophied. The bone fragments were out of alignment and the silver wire broken.

On January 24, 1920, at operation by Doctor Torek, the ends of the bone were found embedded in a mass of fibrous tissue involving the muscles. The muscles and fascia were dissected free from the bone ends, and the bone ends were sawed off square. Parallel cuts about $\frac{1}{2}$ inch apart in the humerus were made with an electric saw to remove a portion of bone 3 inches long from the upper fragment and a portion $1\frac{1}{2}$ inches long from the lower fragment. These excised portions were then transposed so that the longer graft was placed below and the smaller graft above. In this way the longer graft bridged the two fragments of the humerus. The grafts were held in place by chromic-gut sutures through drill holes in the shaft. A plaster case was applied. The patient was discharged from the hospital ten days after the operation. The case was removed seven weeks after the operation and the union was found to be firm. The patient has full use of his arm.

BONE GRAFT OF TIBIA

Doctor Torek presented this patient whose history, he said, was very similar to that of the first case inasmuch as other methods of treatment had been tried. This man fractured his leg in 1914. He was first treated in the ordinary way and a plaster splint applied. This treatment was unsuccessful. The same physician who had given this treatment then used silver wire, and this also was unsuccessful. He was operated upon in a hospital in 1915, when a Lane plate was applied. This, too, was unsuccessful and hyperæmia treatment was instituted by the application of a Bier's bandage. The latter treatment was likewise unsuccessful. Blood was then injected at the fractured ends of the bone in the hope of stimulating nutrition. Finally, in January, 1916, he came under Doctor Torek's care.

At operation, as in the first case, he took a longer graft from the upper fragment and a shorter one from the lower fragment. These he transposed as in the first case shown, thus filling the opening, the only difference being that in this instance the graft was taken out with the chisel instead of with the electric saw as in the first case.

The man now uses his leg perfectly well, the only difference between this leg and the other is that there is some shortening which is unavoidable due to the sawing off of the fibrous ends of the bone.

THE RECONSTRUCTION OPERATION FOR UNUNITED FRACTURE OF THE NECK OF THE FEMUR

DR. ROYAL WHITMAN presented a woman, aged sixty-five years, on whom he had operated for ununited fracture of the neck of the femur in August, 1916, by what he would call the reconstructive method.

In brief, it consisted in removal of the head of the femur. The base of the trochanter was then cut through at its base in the line of the neck and was transplanted to the outer aspect of the shaft.

In this manner a neck was reconstructed by adding the area from which the trochanter had been removed to the remnant that persisted. This extremity was then thrust completely within the acetabulum, the limb being abducted about 25° , and the trochanter with its attached muscles was attached to the outer surface of the shaft as far downward as the tissues would permit. Thus a muscular sling was provided to support the limb, while the projecting trochanter assured the required leverage for muscular control. When the limb was abducted the tissues

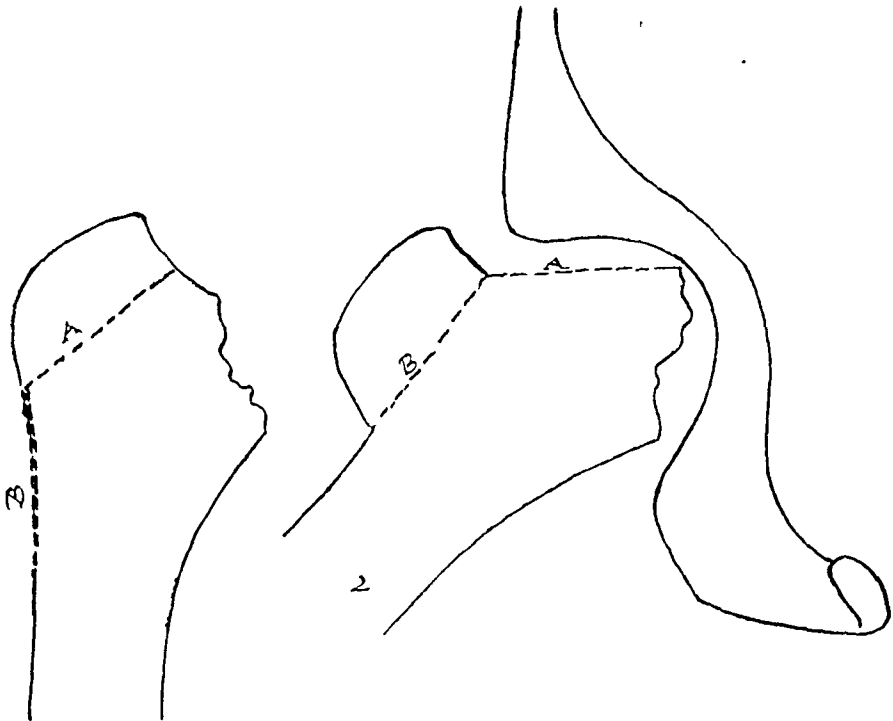


FIG. 1.—1. The upper extremity of the shaft. A, the lines of separation of the trochanter. B, the point to which it is to be transplanted. 2. Showing the reconstructed neck inserted in the acetabulum at about 25° degrees abduction.

were attached to the trochanter and one could place the trochanteric flap upon the femur and hold it in position by sewing the muscles over it. In recent cases he had bored a hole through trochanter and the shaft of the femur and fastened the two with kangaroo tendon; this, he felt, was a little safer.

The patient presented, the first of a series of cases treated by this method, would illustrate what might be accepted as a final result. She was before the operation completely disabled, suffering almost constant pain. She now was free from discomfort. The limp was no greater than that of the so-called favorable results of conventional treatment and the range of controlled motion was sufficient for all functional requirements.

Doctor Whitman said that ununited fracture of the neck of the

BONE GRAFT FOR UNUNITED FRACTURE OF TIBIA

femur was a painful as well as a crippling disability for which, except in the early cases in which bone grafting seemed feasible, there was at present no accepted treatment. He thought the reconstruction operation was a practical solution of the problem.

A large number of lantern slides were shown illustrating the details of the operation and the results as demonstrated by X-ray pictures of the cases.

EPITHELIOMA IN SINUS OF OLD OSTEOMYELITIS

DR. JAMES M. HITZROT reported a case of epithelioma in a sinus of an old osteomyelitis and exhibited the specimen and röntgenograms. The patient was a man, aged fifty-eight years, who thirty years before admission to the New York Hospital had been kicked on the right shin by a horse. Several days afterward an abscess developed on the leg, and subsequently he was operated upon for an abscess in the bone. He had had in all seven operations for an osteomyelitis of the tibia. Five weeks before his admission to the hospital the pain had increased and the discharge which before that had been simply a small quantity became foul smelling and profuse. The clinical diagnosis on admission was perfectly obvious. Around the region of the sinus there was a purplish-blue fungating mass resembling epithelioma which bled rather easily when touched (Fig. 2).

Amputation was done through the upper third of the tibia, using anterior and posterior flaps, care being taken to make the amputation in healthy normal bone. The specimen, somewhat mutilated, owing to the fact that the pathologist had removed a section, showed the region of the ulcerated area on the lower portion and the region of the epitheliomatous mass.

The patient made an uninterrupted convalescence. There were no lymph-nodes in the groin. The patient had gone out of the city, but so far as Doctor Hitzrot knew there was no evidence of recurrence. The case was reported because of the unusual complication in osteomyelitis.

DR. JOHN F. ERDMANN recalled three somewhat similar cases in which he had performed amputation. One of these cases was in the Alms-house, another in the Gouverneur Hospital, and the third in the Post-Graduate Hospital. They were diagnosed as carcinomatous degeneration about the sinus.

BONE GRAFT FOR UNUNITED FRACTURE OF THE TIBIA

DR. JAMES M. HITZROT presented a man, aged twenty-six years, who entered the New York Hospital in July, 1920, with a history of fracture of the left tibia from a shrapnel wound received in France twenty months before admission. Fourteen months before admission he had a bone-grafting operation at General Hospital No. 31, a rib having been used for the graft. Four months before admission he was discharged as cured, and was given a 15 per cent. disability.

On admission there was an ununited fracture in the lower third of the left tibia with false motion at the front line, and a definite antero-posterior angle which had been slowly increasing. The X-ray showed

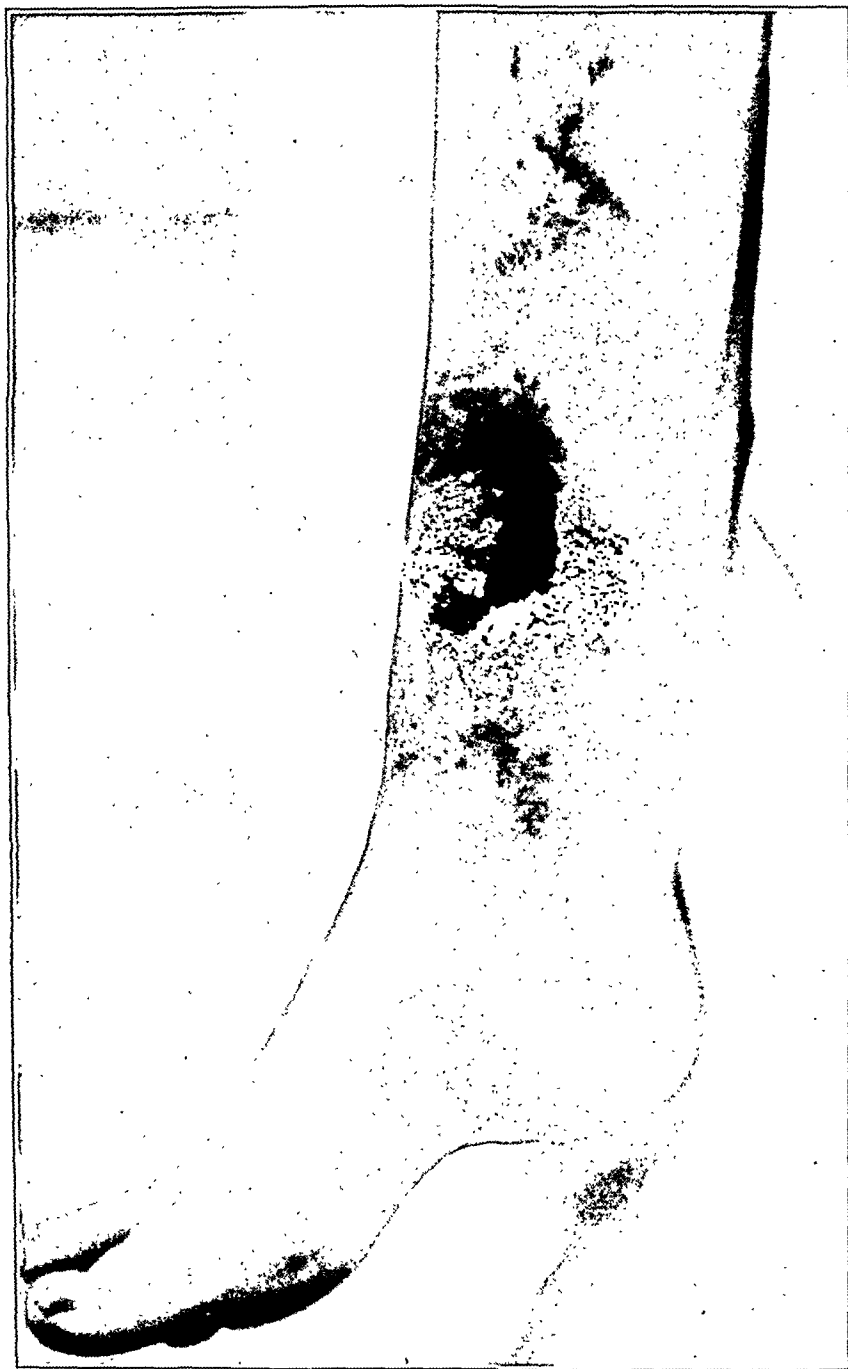


FIG. 2.—Epithelioma in sinus of old osteomyelitis.

an ununited fracture with remnants of the graft above and below the line of fracture. On July 9th, a graft $\frac{3}{8}$ by $7\frac{1}{2}$ inches, taken from the left tibia above the line of fracture, was placed in a prepared groove across the line of fracture and countersunk in the cancellous bone of the

INTESTINAL RESECTION FOR OBSTRUCTION

lower fragment. Drill holes were made through the sclerotic lower end of the upper fragment, partly to fasten the graft in place by bone pegs and also to allow it (the sclerotic bone) to become vascularized. The lower end of the upper fragment resembled ivory in its density and was extremely hard, with no medullary cavity, while the lower fragment was porous and filled with fatty marrow. The case was shown to illustrate: (1) The failure of the rib graft. In Doctor Hitzrot's experience the rib was not sufficiently strong to act as a graft in weight-bearing bones. (2) Fracture of the tibial graft inserted at the operation, and repair of the fracture in the tibia despite this fact. (3) The drilling of the sclerotic bone to allow for more rapid vascularization. (4) Countersinking of the graft in the lower fragment to get good endosteal contact and to help in fixing the graft—a method which helped when one had to deal with a short fragment at one side of the fracture.

The man has now solid union and the X-ray fourteen weeks after operation shows a good mass of new bone across the line of fracture. In reply to the question why there was porosity in the lower fragment with a sclerosis in the upper fragment, Doctor Hitzrot said he was unable to explain why there was porosity in the lower fragment and sclerosis in the upper fragment, unless the sclerosis was the result of an inflammatory process and the porosis the result of disuse. In regard to the question of periosteum, he had had the experience that endosteal contact was more important than periosteal contact, and he had not been using periosteum in his transplants for a long time and thought he obtained more successes without than with periosteum.

INTESTINAL RESECTION FOR OBSTRUCTION FOLLOWING APPENDECTOMY

DR. J. H. KENYON presented a man aged twenty-six years, born in Austria, a furrier by occupation, who was admitted to the Fordham Hospital, February 19, 1920. Five months before that time he had been operated on at another hospital in this city for acute appendicitis with abscess. He had been sick four days. The appendix was removed and a rubber tube about one-half inch in diameter was inserted for drainage. On the third day two smaller tubes were inserted alongside of the larger one for irrigation which was done every day. The tubes were not removed until the twelfth day, when a gauze drain was substituted. He left the hospital on the seventeenth day, but the wound was not healed until several weeks later. There was some weakness and bulging of the scar and his physician told him that another operation would be necessary.

Except for a poor appetite, some abdominal discomfort which he described as indigestion and some constipation he felt fairly well, though he said that his stools showed a small amount of blood occasionally.

On the day of his admission to the Fordham Hospital, five months after his appendectomy, he was awakened at 3 A.M. with severe pain in

his abdomen, not particularly localized, but rather more severe in the lower right quadrant. An hour later he vomited greenish material and his physician who saw him about this time advised him to go at once to the hospital for an operation, but he decided to wait. Enemata returned clear, no gas or fecal material was passed; morphine did not relieve the pain. Vomiting continued at frequent intervals all day, and at 7 P.M. became fecal, and then he decided to go to the hospital. When seen shortly after his admission, and twenty-one hours after the onset of the pain, he was acutely ill, had severe abdominal pain and was vomiting at frequent intervals. The abdomen was distended, tympanitic, and quite tender in the right lower quadrant, especially over the old scar which showed a diffuse bulging rather than a strangulated hernia through a small opening. Temperature, 101.5° ; pulse, 98; respiration, 20.

The operation was started at once. When the abdomen was opened through a right rectus incision, just above the old one, bloody fluid escaped. Exploration with the finger showed the inner margin of the former incision to be free from adhesions, so the opening was enlarged downward in that direction. The abdominal wall along the outer margin of the opening and also the thin portion of the scar were adherent to the anterior surface of the cæcum. These adhesions were liberated. The small intestine was distended and near the cæcum was deep purple in color and rotated, counter clockwise one and a half turns. When this loop was untwisted a strong band could be seen passing from a point near the ileocecal junction to the mesentery, tightly constricting the two legs of this loop; when this band was cut, the normal lumen and curvature were restored and the intestine could be lifted up into the wound. Hot, moist pads were applied, but there was no improvement in the condition and a resection became necessary. The portion removed measured fourteen inches.

The patient's condition was not very good, and it seemed that an anastomosis with a Murphy button would be quicker than the more preferable one with a suture. The distal stump was rather short, only about one inch long, and it was thought that the button might pass more readily if one-half were placed directly in the cæcum; accordingly, the distal stump was closed with a continuous suture of chromic catgut and then inverted with a purse-string suture of linen and an end-to-side anastomosis was made into the anterior surface of the cæcum about one inch above the ileocecal junction. Purse-string sutures of linen were used to hold the button in place, interrupted sutures of catgut were used in the mesentery but no reinforcing peritoneal sutures were placed.

A cigarette drain was inserted down to the pelvis and brought out at the lower end of the wound. The usual closure in layers was made, with plain and chromic catgut, silkworm gut and silk for the skin. No special attempt was made to repair the hernia because of the patient's condition. Usual dressing.

INTESTINAL RESECTION FOR OBSTRUCTION

The patient made a good recovery. Daily enemata, beginning the day after the operation, were effectual. Soft diet was given on the third day. No cathartic was given by mouth until the eleventh day. The cigarette drain was loosened and shortened each day and entirely removed on the fifth day. Sutures out on the eighth day, wound strapped. Patient sat up on the twentieth day and left the hospital at the end of four weeks.

The button was never recovered but as shown by the X-ray pictures must have been passed some time between the fifteenth and twenty-fourth day.

At the present time, nine months after the operation, the patient feels very well, has a good appetite, normal movements without any blood. The hernia in the scar is about the same as before and will require another operation.

DR. JOHN F. ERDMANN stated that he had not used the Murphy button for some ten to twelve years because he had had the misfortune to have one slough through the intestine; ever since that time he had used suture, claiming suture to be quite rapidly applied in the skillful operator's hands and that danger of slough and foreign-body retention were done away with.

DOCTOR TOREK said he saw no objection to using a Murphy button. He recalled an unpleasant experience with an end-to-end anastomosis of the small intestine by the suture method. Obstruction followed and the patient died. Autopsy showed the obstruction to be due to bleeding into the tissues at the site of the end-to-end suture which was of such a character that the lumen of the gut was closed by the bleeding. That, of course, would not have happened if a Murphy button had been used.

DR. EUGENE H. POOL said he had not been using a Murphy button if it was possible to avoid it, for the reason that occasionally it had been known to slough through and cause sad results. He recalled a case operated upon by another surgeon in which a Murphy button was used for a gastroenterostomy after pylorotomy. The patient seemed to be making good recovery and after three or four weeks was able to go out driving. Then she was seized with an attack suggesting acute appendicitis. The patient died and the Murphy button was found about twelve inches from the ileocecal junction. It had perforated through the wall of the intestine and about it was quite an accumulation of pus. A Murphy button, like any foreign body, is likely to cause obstruction. If arrested it is liable to ulcerate through and should never be used where its arrest is likely to occur. In this connection Doctor Pool also recalled a case reported by a British surgeon of a boy who had sustained rupture of intestine at duodeno-jejunal junction. The duodenal end was closed and a gastro-jejunostomy done with button. The button dropped into stomach, passed to the blind duodenal loop, ulcerated through, and caused death.

DOCTOR DOWNES said he understood that a well-known surgeon had been quoted as saying that the Murphy button would soon be passed along with the various relics of antiquity. It had answered a tremendous purpose when it was brought out, but now that the use of the suture had been perfected he thought that most surgeons were agreed that suture was better and that the use of the button was seldom indicated.

TORSION OF THE OMENTUM WITH ACUTE APPENDIX

DR. JOHN F. ERDMANN presented a boy, aged fourteen years, who was admitted to hospital on October 18th, with a history of onset of appendicitis. He complained of nausea, vomiting and umbilical pain, localization of pain in the loin and in the midway portion of the right half of the abdomen. Thinking the appendix might be one of those with non-rotation, the incision was made rather high. The appendix was found floating rather free. Further exploration revealed a dark mass in the neighborhood of the gall-bladder which proved to be the right half of the omentum, twisted three times from right to left on itself, which was necrosed. The necrosed mass was excised and the suppurating appendix was removed.

Doctor Erdmann said that this was the first case of strangulated omentum that he had seen in thirty years' experience, though he had heard a few such cases reported and there were a few described in the literature.

DR. LUCIUS W. HOTCHKISS recalled that he had shown a case before the society several years ago (1907) in which torsion of the great omentum had occurred. In this case symptoms had followed the spontaneous reduction of a right-sided inguinal hernia which became temporarily irreducible. A large mass of omentum twisted on its vertical axis, contra clockwise, about eight times, close up to the transverse colon, was removed. It was beginning to show necrosis at the tip. Its weight was over five pounds and it measured about ten inches by six inches. It was adherent at some point about the brim of the pelvis. The specimen resembled a hepatized lung in color and consistency. The condition was a very rare one.

ASTRAGALECTOMY AFTER CHOPART'S AMPUTATION

DR. ROYAL WHITMAN presented a girl, aged seventeen years, upon whom at the age of five a Chopart's amputation of the right foot had been performed. The extremity was serviceable until she was fourteen years old, but since then she had suffered persistent discomfort.

The stump presented a typical equinus deformity, the projecting head of the astragalus (Fig. 3) being surmounted by a deep callous ulcer. The ulcer was first excised, and the astragalus was then removed through the usual external incision. The upper part of the os calcis was cut to a plane surface and it was drawn forward and adjusted to the malleoli in a position for normal weight-bearing. The peronei tendons on the outer,



FIG. 3.—Condition of tarsal bones twelve years after a Chopart's operation.

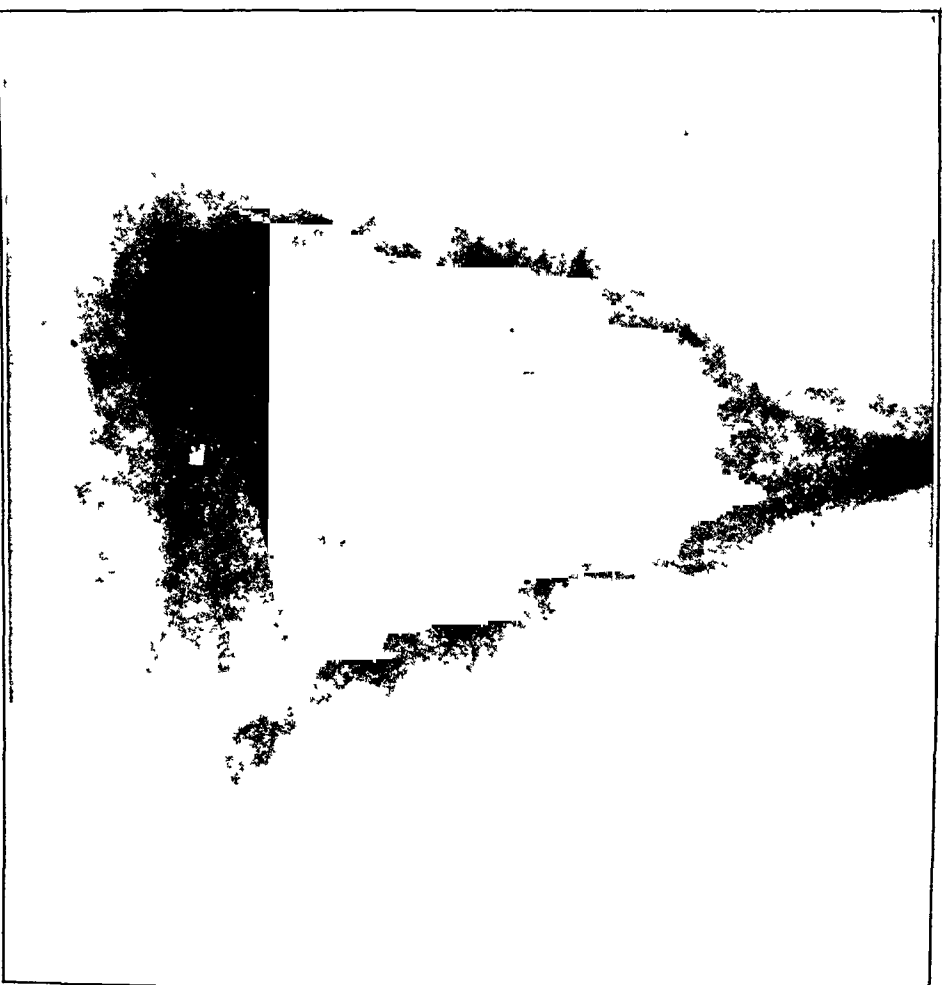


FIG. 4.—Condition of bones shown in Fig. 3 after resection of the astragalus.

and the tibialis anticus on the inner side, were attached to its anterior extremity and the wounds were closed.

The changed relation is shown in the X-ray pictures (Figs. 3 and 4), the original Chopart's stump having been changed to that of a modified Pirogoff. There was a slight range of voluntary motion between the os calcis and the tibia which seemed to be advantageous in lessening the direct jar. The functional result was entirely satisfactory.

In a similar but less extreme case now under treatment at the hospital, the tendo achillis was lengthened and such of the anterior tendons as could be freed from the scar tissue were implanted on the plantar surface of the stump, restoring the full range of voluntary dorsal flexion.

Doctor Whitman thought that conservative operations of this type were to be preferred, in childhood at least, to amputations above the ankle, as a weight-bearing heel was preserved. Chopart's amputation had fallen into disrepute because of the failure to provide a secure attachment for the dorsal flexors; thus, consequently, equinus deformity and its consequences were inevitable.

BONE GRAFTING—STUDY OF A SERIES OF CASES OPERATED ON IN U. S. ARMY HOSPITALS

DR. JOHN B. WALKER presented a paper with the above title, for which see page 1, January, 1921.

DR. CLARENCE A. McWILLIAMS mentioned the methods of free bone grafting which have been used.

1. Osteoperiosteal grafts according to the method of Delangiere. This is a very successful method and it has not been accorded the notice that it deserves. Delangiere performed 273 operations by this method of which 244 resulted in cures. These grafts consist of periosteum and a thin sliver of bone the thickness of a dime. The grafts could be moulded about a fracture point or made to fill in a bony defect.

2. Intramedullary graft, of necessity without periosteum.

3. Inlay with periosteum:

(a) Sliding.

(b) Free, from another site.

4. Lateral, overlying graft always with periosteum.

5. End-to-end graft always with periosteum.

Doctor McWilliams said that if one had the choice between the intramedullary graft and the inlay, one should use the inlay method as being more physiological, because in the inlay we had periosteum and all the layers of bone brought in contact with corresponding layers of the host, while in the intramedullary graft there was no periosteum on the graft, consequently a frequent result of the intramedullary graft was that it was absorbed. Thus, Campbell reported having grafted eight cases, four by the intramedullary method and four by the inlay. All four intramedullary grafts were absorbed while all four inlay grafts remained intact. The speaker said he had in mind an intramedullary graft inserted

by a colleague over a year ago in an ununited fracture of the humerus, which graft, notwithstanding primary union, had now undergone marked absorption and the fracture was still ununited. In making a transplantation of bone, one should choose a method, *i.e.*, the inlay which would permit the retaining of the periosteum on the graft, since the periosteum markedly increased the osteogenic properties of the graft. Delangiere had proved in his 273 osteoperiosteal graftings that a layer of bone with its periosteum produced new bone, that the osteoperiosteal transplant acted not only as a graft, but that it secreted bone. Contrary to the experience of the results of intramedullary grafts, he had never observed absorption of the grafts.

It was difficult to reconcile the various views as to the function of the periosteum. Renfrew White said: "The osteogenetic properties of the periosteum, which it seems to possess, are in fact not its own, but due to a resumption of osteoblastic activity of the cells of minute portions of bone that have adhered to it, having been detached with it."

That there might be an actual outpouring of osteoblasts from the surface of the bone when the periosteum had been ruptured by injury was proved by the reports of cases of traumatic myositis ossificans. It might be that the chief function of the periosteum was circulatory and nutritional, small blood-vessels dipping into the cortical bone from the periosteum—witness the oozing of the blood on a surface of a bone caused by the stripping off of the periosteum. Whatever the specific function of the periosteum was, and this seemed still to be in doubt, all operators agreed now that in making a bone graft the periosteum should be retained on the graft, provided that it was necessary that the graft, to fulfill its function, should not be absorbed, as in the case where a defect was to be filled in by the graft. An intramedullary graft which was implanted without periosteum served merely as a temporary internal splint and was usually absorbed later. Its powers of osteogenesis were feeble, generally speaking. To obtain a graft with the greatest osteogenetic power, one should have periosteum on the graft. Doctor McWilliams concluded from his own experience and from what he had gathered from the literature that the intramedullary splint should be generally discarded because it was but feebly osteogenetic and frequently became absorbed. The inlay method, either sliding or transferred from another site, was much the most certain method in its results when it could be used, since it was most strongly osteogenetic and not liable to be absorbed. When it could be used, owing to the shortness of one of the fragments, the osteoperiosteal graft, as transplanted by Delangiere, should be used. This graft was likewise very strongly osteogenetic and would not be absorbed and could be moulded about an ununited fracture or about a defect to be filled in. The intramedullary graft should be used only when a temporary internal splint was to be provided.

DR. SEWARD ERDMAN asked Doctor Walker whether he had any statistics showing how long a period of time had elapsed from the time of

BONE GRAFTING

complete healing until operation. Doctor Walker had said that there was an average of 234 days from the time the wound was received until operation, but the fact should be taken into consideration that many of these cases were complicated with osteomyelitis and lay in the hospital with an open wound and osteomyelitis for a long time untreated. It would be interesting to know how long a period elapsed from the time of complete healing until operation was performed, for upon the theory of latent infection in the recently healed wounds, he believed that at least four to six months should intervene between the complete healing of wound and the bone operation.

DOCTOR WALKER, in reply to Doctor Erdman, said the Surgeon General's Office did not have the records available of a large number of cases giving the period of time which had elapsed between the date of complete healing and the date of operation, but from such statistics as were available the result seemed to depend more upon the duration of the original infection than upon the length of time that had elapsed from the date of complete healing until operation. For instance, if a wound had been infected for six months it would be more apt to become infected following bone grafting operation than if it had been infected for only three months. If one took a large number of cases that had been infected for six, eight, or ten months a larger number would be infected following operation than in a similar series in which infection had lasted only three or four months. In the cases he reported non-union had occurred in about 6 per cent. Some writers reported a series of cases in which the percentage of non-union was 12 and 15 per cent. There was a large number of cases classed as non-union, in many of which if one waited six months one would find the union had eventually taken place, so he thought the percentage of non-union was under rather than over 10 per cent.

With reference to the selection of a rib for a graft: he knew of several surgeons who had formerly used ribs and who had come now to the conclusion that the rib should not be used as a graft in those cases of the lower extremity where it would be subjected to weight-bearing. While there was greater cellular activity in a rib graft, it was also true that it would be absorbed more quickly and before new bone could be replaced. More fractures occurred after rib had been used than where the graft had been taken from the tibia. Again the result depends much upon the length of the space which separates the two ends of the fragments. If the ends of the fragments were five centimetres apart a much larger graft should be used than if they were three centimetres apart. Grafts from the rib have been used in repairing defects of the jaw, but later the graft taken from the crest of the ilium seemed to be preferred. For fractures of the radius and ulna, if the ends of the fragments were only two or three centimetres apart one could use smaller grafts. Probably the reason the rib graft gave way in Doctor Hitzrot's case was because it was too small to be used in the lower extremity.

BOOK REVIEW

LES FRACTURES DU COL DU FEMUR. PAR ANTOINE BASSET, Professeur Agrégé à la Faculté de Médecine de Paris; Chirurgien des Hôpitaux. Annales de la Clinique Chirurgicale du Professeur Pierre Delbet.

Under the above title, Doctor Basset has written an exhaustive monograph on fractures of the neck of the femur. There are 320 pages, followed by reports of 107 cases, and 22 pages of X-rays and other illustrations.

He divides his subject-matter into ten chapters: (1) Classification, (2) Etiology, (3) Architecture of the Neck, (4) Blood Supply of the Neck, (5) Pathological Anatomy, (6) Anatomical Development, (7) Symptoms, (8) Course, Complications and Prognosis, (9) Diagnosis, (10) Methods of Treatment.

Some of the interesting points brought out by Basset's investigations are these: He has injected the blood-vessels of the head and neck of the femur, which spring from two main trunks, the obturator and the femoral. The posterior terminal branch of the obturator artery is the acetabular, which finally penetrates the ligamentum teres and through it reaches the head of the femur, where its arterioles anastomose with the terminal branches of the circumflex arteries supplying the neck. The blood supply of the base of the neck is much more abundant, derived from the anterior and posterior circumflex arteries, branches either of the femoral or profunda femoris. He finds that in the foetus the arterioles penetrate only superficially the cartilaginous tissue and that the zone of union of the head and neck contains very few vessels. There is then no anastomosis between the artery of the round ligament and the circumflex system. In adolescence this condition changes, the anastomosis develops, and the blood supply of the head becomes very rich. In the adult the supply of the head and neck gradually diminishes. Finally in the aged there is a striking diminution in the number and calibre of the vessels supplying the base of the neck and the region of the trochanter.

He maintains that the blood supply of the head persists at least up to sixty-seven years, having examined a specimen at that age. He does not deny the possibility of its failure at a greater age, but strongly doubts it. This point is stressed as it is essential for him to convince his audience that the head always lives, the viability of the head being a necessity in the subsequently described operative treatment. He cites Lambotte as having stated that the head after fracture was exposed to dry arthritis, necrosis and even suppuration (sic); a possibility which seems to be exaggerated.

He concludes (1) that in old people the most common type of fracture is the cervico-trochanteric. (2) In young and middle-aged subjects, while the fractures are usually by decapitation or through the neck, the nutrition of the head is always assured by the artery of the ligamentum teres.

These conclusions are interesting, as hitherto it has always been adduced in support of the proposition that intracapsular fractures (*i.e.*, through the neck) could not unite, that they occurred most commonly in the aged. Basset, however, directly contradicts this, and later makes the statement that the cervico-trochanteric fracture characteristic of the aged will unite under any form of treatment.

His classification of the type of fractures as (1) by decapitation, (2) transcervical, (3) cervico-trochanteric, (4) trochantero-diaphyseal, seems to me greatly preferable to our vague and misleading "intra- and extra-capsular," and I should recommend its adoption. Basset rejects all statistics bearing on the success of any form of treatment because the exact type of fracture was not specified, a point which looms large, as he later states (page 193) that "fracture by decapitation and transcervical fractures regularly terminate in pseudarthrosis."

He states that the aims of treatment of fracture of the neck of the femur are the following: (1) To obtain consolidation in the best possible attitude of the fractures which do not unite by bony callus—that is to say, of true cervical fractures, which end in a pseudarthrosis with pain, progressive shortening, and finally almost complete infirmity. (2) To obtain consolidation in correct attitude, of fractures which unite by bony callus, that is to say, the cervico-trochanteric variety. (3) To get the patients up as soon as possible. (a) In order to avoid pulmonary, urinary and cachectic complications in old patients (cervico-trochanteric fractures). (b) In order to combat muscular atrophy and to correct it if it exists (in old fractures) and to avoid it if it does not exist (in recent fractures).

Upon the state of the musculature of the limb will depend, in large part, the quality of the functional result.

He then describes at length the various methods of treatment, giving a full, clear and accurate account of the abduction method, but being sceptical of its success because he cannot conceive of a plaster spica extending from the ribs to the toes being comfortable; nor can he conceive how a patient so encased could be turned upon the face or moved about.

The last chapter appears to be the *raison d'être* of the book and is a description of Doctor Delbet's operative method. It is apparently his custom to operate on all cases, because (1) he believes that fractures by decapitation and transcervical fractures never unite under any treatment other than operative (page 262). (2) He, as he believes that cervico-trochanteric fractures normally unite under any form of treatment, concedes that all methods are capable of giving more or less favorable results. He objects to the abduction method because of the difficulty of the application of the plaster, its burdensomeness to the patient, and the length of the treatment. (3) He objects to arthrotomy as exposing the patient to grave risk, and still further compromising an already compromised blood supply.

The patient is placed upon the table with traction on both legs to reduce

the shortening, and the great toes tied together. The surgeon makes an incision over the base of the greater trochanter, and having determined the position of the head, and the angle and inclination of the neck by the use of a special instrument Doctor Delbet has devised, or by radiography, he introduces a wooden screw through the neck into the head, and thus presses the fragments firmly together. The screws are made in lengths of 7, 8, 9 cm., according to the individual case. The diameter is always 6 mm. The thread is made unusually deep. He believes that the screw "plays a transitory but very important rôle. It causes osteosynthesis, maintains the reduction of displacement and the accurate and close-pressed coaptation of the fragments" (page 270). The screw soon becomes loose, but it has not been necessary to remove it except in a few exceptional cases where it had slipped, being badly placed, or at the request of the patient.

In the cases of old fractures with pseudarthrosis he substitutes for the screw a bone graft consisting of a section of the shaft of the fibula from which all the periosteum has been carefully removed "in order to open the Haversian canals giving on the surface of the graft, and to facilitate the establishment of vascular connections between it and the bony tissue in the midst of which it is introduced." Doctor Delbet believed at first that this graft would simply serve to bear the weight of the patient and would not generate bone (page 280). Doctor Basset now believes that there has been definite formation of new bone in five cases of pseudarthrosis, in which the radiograph has shown reconstruction of the neck. In the two classes of cases he believes "that in the first period the screw and the graft have the same advantage. The first in recent fractures and the second in pseudarthroses permit one to make the patients get up and walk some days after the operation." He finds, that, though the graft has been taken from the fibula by an "imperfect subperiosteal resection" and the periosteum having retained throughout its vascular connections, there has been no regeneration of new bone in the shaft of the fibula.

As soon as possible after the operation and not later than the fourth or fifth day one begins muscular exercises. One makes the patients contract the muscles of the thigh and stiffen the leg without moving it. These exercises are very important, for almost all these patients, and above all those operated for pseudoarthrosis, have muscular atrophy, which hampers them extremely when they begin to walk.

The period at which the patients get out of bed varies according to two conditions: (a) According to whether it is a question of recent fracture treated by screwing, or pseudarthrosis treated by an osseous graft, (b) according to whether or not one has applied the "appareil de marche à extension continue" (walking splint with continuous traction) (I shall refer to it for convenience as Delbet's splint).

"After screwing, patients not provided with Delbet's splint get up from the twelfth to the thirtieth day; those who have it, from the third to the

thirteenth day. After graft, those without the apparatus get up from the twentieth to the sixtieth day, and those with it from the tenth to the fortieth day.

"From the moment that the patients get up, whether it be a question of screw or graft, and whether or not one has applied the Delbet splint, one makes the patients first walk with crutches, obliging them (and this is important) to concentrate on making correct movements of walking. As confidence returns they pass from crutches to canes. In general, progress is slow, especially when the pseudarthrosis is of long standing. But usually they improve with time, above all when energetic and persistent patients take pains to perfect their gait."

After the operation, and in spite of it, it happens in certain cases that walking remains during a certain time, sometimes very long, difficult and defective. There are several reasons for this—"timidity of the patient, muscular atrophy, a certain limitation of motion in the hip, a little shortening and slight external rotation of the limb."

In summarizing Doctor Delbet's operative results in the table below I have classed as "perfect" those cases resulting in "restitutio ad integrum," those able to walk well and go about their ordinary affairs with little if any pain I have called good. I have counted out all results under six months following operation, as I am convinced that under that time, at least, one can never be certain that bony union has taken place.

He also cites five cases of cervico-trochanteric fracture treated by the Delbet splint alone, of which the results seem quite as good as those in which the operation was performed. The number of cases in which a second operation was necessary or in which there was imperfect position of the screw or graft confirms the impression that the method is distinctly one to be employed only by the expert.

Treatment by Decapitation.—Insertion of screw—5 cases. Results: Perfect, 1; good, 2; unknown, 1; too soon to classify, 1.

Transcervical Fractures.—Insertion of screw—26 cases. Results: Perfect, 3; good, 7; failure, 2; too soon to classify, 8; unknown, 2; deaths, 4.

Cervico-trochanter Fractures.—Insertion of screw, 14. Results: Perfect, 1; good, 3; too soon to classify, 5; unknown, 1; deaths, 4.*

Pseudarthrosis-Fibular Graft.—Twenty-five cases (11 fractures by decapitation, 12 transcervical). Results: Good, 12; failure, 15; too soon to classify, 4; deaths, 2.

We have, then, out of a total of 107 cases observed 70 selected as suitable for operation. Of these 70, 25 were cases of pseudarthrosis, leaving 45 cases of fresh fracture operated upon by Doctor Delbet's method. Of these 45, 17 results were perfect or good. There were 7 deaths and 2 failures, the others either were too early to report as final results, were poor, or were lost track of.

* One as result of accident six months later.

For purposes of record, therefore, all that we are entitled to say of the operative treatment is that by its use good results have been obtained in 37 per cent. of cases, and that it has been attended by a mortality of 15 per cent. Only 54 per cent. of cases were considered suitable for operation.

I have quoted Doctor Basset at great length because I wished to be accurate and to be certain that I had stated his case fairly. The preliminary chapters are so excellent and the scale of the work so monumental, that there is great danger of the superficial reader, and particularly of the general surgeon, thinking that one who writes so carefully must reason equally well, and adopting his conclusion that all fractures of the neck of the femur should be treated by operation.

Taking up his case categorically, therefore, I begin with the statement that fractures by decapitation and transcervical fractures never unite under ordinary treatment (page 232). Sir Astley Cooper cites a case which united under no treatment whatever, Willis Campbell gives a series in which the cases were carefully divided into intra- and extra-capsular fractures in which be obtained union in twenty-four out of twenty-nine of the first variety. (ANNALS OF SURGERY, November, 1919). Let us concede, however, that all statistics are false, and that Doctor Basset is correct in his statement. What then is the magic power inherent in the wooden screw? "It maintains the reduction of displacement and assures close-pressed coaptation of the fragments" (page 270). Proper reduction of a recent fracture and maintenance of full abduction will give as close-pressed coaptation as can any screw. The curiously minded may verify this statement for themselves either by open operation or investigations on the cadaver. This is not true of old cases in which the neck has been absorbed, and it is unfortunate that Doctor Basset did not separate his cases into fresh and old fractures. Also, he says that the screw eventually becomes loose. He particularly says that it is not inserted for the purpose of bearing weight; but there is some confusion on this point, as on page 268 he objects to the use of a thin nail as being "too feeble to support the weight of the body when one gets the patient up;" that at the end of a certain time a rarefying osteitis is produced about it, and that it plays freely in the enlarged canal. From my experience I should say that six weeks would certainly have seen the establishment of this condition. The diameter of the neck is about 16 mm. The diameter of the screw is 6 mm. Having thus diminished the potential strength of the bone at least one-third, does it not seem remarkable that the patient should be encouraged to bear weight upon it as soon as the twelfth to the thirteenth day? This seems the more extraordinary when we remember that this is the only fracture except oblique fractures where the body weight falls directly across the line of fracture. We are all familiar with the solicitude displayed to keep patients with oblique fracture of the femur or tibia from bearing weight until such time as consolidation shall have become secure.

How are we to explain the fact, then, that in the face of these seemingly

grave mechanical and pathological difficulties a wooden screw caused firm bony union? Probably, I think, by the fact that the patients themselves used their crutches longer than their observers supposed, or wished to suppose, and that Doctor Delbet's splint, which I regret Doctor Basset does not describe in detail, prevented them from bearing any weight upon the injured limb. I am strengthened in this opinion by the fact that in three cases of pseudarthrosis (xlv, lvii, lxxviii) the graft taken from the fibula broke. If the whole diameter of the fibula could not sustain the body weight, I find it almost impossible to believe that new-formed callus with no external callus, and only a loose-playing 6-mm. wooden screw to reinforce it internally should be capable of doing so at such an early period as the twelfth to the thirtieth day. Probably Doctor Delbet's splint takes the body weight upon its upper ring, as does the ordinary traction hip splint which we are accustomed to use. I am practically certain of this point because Doctor Basset refers to it as "*l'appareil de marche a extension continue*" (walking apparatus with continuous traction) and obviously no traction could be possible were weight borne upon the limb. The object of the operation in fresh cases, therefore, becomes simply efficient fixation of the fracture, which may be equally obtained by non-operative means. The recommendation of the operation for all cases is a vicious practice, however, because in many cases deformity is not reduced, as Doctor Basset himself states. Without arthrotomy, having no control over the head fragment, abduction to the normal limit is the only position in which form is restored, and one cannot reiterate too often that restoration of form is the essential preliminary to the expectation, even, of restoration of normal function.

In fractures of the cervico-trochanteric variety, which Doctor Basset states will unite under any form of treatment, the performance of the operation is still more inexplicable. Its only purpose could be the correction of deformity and this it does not do.

In cases of pseudarthrosis the question is quite different. Then the neck has usually atrophied and has disappeared, and any operation which will get union of the parts that remain, and provide a stable, painless, weight-bearing extremity is to be commended. Certainly the pegging operation, if one is possessed of the necessary skill, is a less formidable and less damaging procedure than arthrotomy, but in the cases of ununited fracture which I have seen the fractured surface of the head was so covered with dense fibrous tissue as to make the possibility of union without freshening the surfaces seem most unlikely. This question, of course, can only be decided by personal experience.

The underlying reason for disquisitions upon the operative treatment of fracture of the neck of the femur is that surgeons in general are unable or unwilling to master the details of and to learn to apply the abduction method. In their anxiety to evade that necessity they seek refuge in various operative

methods under the excuse of age, or character of the patient, with the familiar refrain that such patients will not stand confinement to bed.

Doctor Basset evidently has studied this method, but that he cannot be familiar with its application is indicated by the fact that he cannot understand how a plaster spica extending from the axillæ to the toes can be spoken of as comfortable, nor how a patient wearing such apparatus can be turned over in bed. Certainly I do not pretend that to be so encased is agreeable, as life in a spica must naturally be in the nature of a strange experience to any but a crustacean. But, I may truthfully aver that such a plaster properly applied may be very far from uncomfortable. The question of moving the patients once the plaster has hardened is simply a matter of strength or skill, and they may be got out of bed if necessary at the end of forty-eight hours. Sir Robert Jones, who habitually uses an abduction frame in his treatment of this fracture, makes it his practice to apply plaster when he particularly desires to get his patients early up and about.

The principles of the treatment of fracture of the neck of the femur have been continually obscured by extraneous matter such as the age of the patient, the desirability of early locomotion, and the fact (?) that intracapsular fractures of the neck did not unite. All those questions may affect the treatment of a given case, but they have nothing whatever to do with the principles governing the treatment of all fractures. The primary essential is the reduction of deformity, and the maintenance of such reduction until consolidation shall have taken place. If deformity is allowed to persist any expectation of perfect function is absurd. Without arthrotomy the normal relationship of the fragments in a fracture of the neck of the femur can only be restored by reducing the shortening and holding the limb in a position of slight inward rotation and at the limit of normal abduction. This is the fundamental principle of treatment, and once it is understood one may expatiate as one pleases upon the discomforts of plaster-of-Paris, the unpleasantness of treating old people, the unwillingness of intracapsular fractures to unite, and the necessity for getting the patients early out of bed.

Whoever undertakes to prescribe one remedy for all cases of a certain injury must have sound reasons for so doing, and has no reason to complain if others of less positivistic tendencies take issue with him.

To restate Doctor Basset's case as briefly as is consistent with fairness, he is dissatisfied with conventional methods of treatment of this crippling injury, and with their wretched results. He is unwilling to accept the abduction method because it is difficult of application, and because if plaster-of-Paris be employed the plaster is heavy, cumbersome and painful to the patient to wear, which he should do for several months. He, therefore, advises for fresh fractures the insertion of a wooden screw, and for old ones with non-union and pseudarthrosis the insertion of a bone graft, consisting of a section of the shaft of the fibula.

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Both methods assure close-pressed coaptation of the fragments and enable the patient to get up and about with the assistance of a splint at periods varying from the third to the sixteenth day, and to begin early to bear weight upon the limb.

In the discussion of such a radical proposition as a standard operative treatment for all forms of an injury one must separate sharply theory and practice. It is a scientific truth that in order to restore the normal form of the bone in a fracture of the neck of the femur, one must either do so by open operation and direct manipulation of the fragments, or, having overcome shortening by traction, to abduct the limb to the normal limit of abduction, to rotate it slightly inward and in such a position to maintain it until bony union shall have become secure. In other words, if one expects a perfect functional recovery, one must apply the same elementary principle to this fracture as to any other reduction of deformity.

If for any reason the application of methods for the reduction of deformity are impossible or inadvisable, one then may have recourse to something else, but with the clear understanding that in so doing one is compromising and sacrificing ultimate function for other more immediate considerations.

The primary weakness of Doctor Delbet's method is, that deformity is not reduced. I consider this point so important that I take pains to give Doctor Basset's own words (pp. 315 to 316): "Why, in the case of which we have just spoken, does there persist after the operation a certain degree of shortening, or a little separation (decalage—literally unwedging of the fragments)?"

It is because in certain fractures, and in particular in certain cases of long standing pseudarthrosis with accentuated deformity, whatever be the continuous traction that one makes upon the foot during the operation, and in spite of the general anæsthesia, one does not succeed in entirely reducing the displacement of the fragments. The introduction of a screw with energetic pressure or the insertion of an osseous graft fixes the fragments in the attitude of slightly imperfect reduction. In my opinion this statement by itself is enough to condemn the method as a standard treatment.

It is evident that Doctor Delbet's interest was aroused by the unfortunate lot of the patient with an ununited fracture, and eventually finding a method of treatment which gave him favorable results in such—the worst cases—he gradually expanded it to the treatment of all such injuries. He probably argued that under conventional treatment there was always a chance of non-union, and that if he could shorten convalescence and insure a firm, weight-bearing extremity, he was justified in the sacrifice of perfect function.

This process of development is in direct contrast to that of the abduction method, which was first tried upon children, later on young

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adults, and very gradually expanded to the treatment of all types of cases. Though it is slowly coming, in this country and elsewhere, to be recognized as the standard treatment, I know of few who would be bold enough to say that it should be applied to every case.

Apart from the author's chapter on operative treatment, I have nothing but praise for Doctor Basset's book. It gives evidence of long and painstaking work in the collection of material, its style is excellent, and the subject is fully covered in all departments. It is a valuable contribution to the literature in a field which has not often attracted investigators of Doctor Basset's ability. I regret that we have in this country so little work that can be compared to it.

ARMITAGE WHITMAN.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

PUBLISHER'S NOTE

SET OF THE ANNALS OF SURGERY FOR SALE

Frequent inquiries are made as to the possibility of obtaining the earlier volumes of the ANNALS OF SURGERY, to which reply has to be always given that only as a set may come into commerce by the dispersion of some library is it possible to obtain them. For the information of such inquirers the statement may now be made that among the books offered for sale from the libraries of the late Doctors Kehr, Richter and Rose, of Germany, is a complete set of the ANNALS OF SURGERY, Vols. 1-54, 1885-1910. The price is 18,000 marks, and the bookseller is Gustav Fock, of Leipzig, Germany.

ANNALS *of* SURGERY

VOL. LXXIII

MARCH, 1921

No. 3.

LIGATION OF THE EXTERNAL ILIAC ARTERY AND VEIN ABOVE AND BELOW A COMMUNICATING BULLET WOUND OF THESE TWO VESSELS *

BY G. PAUL LA ROQUE, M.D.

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PISTOL bullets and stab instruments are the causes of approximately 80 per cent. of all cases of wounds of large arteries and veins in civil life. Fracture in the region of the shoulder and hip;⁹ accidental incisions or tears when operating upon such affections as hernia, abscess, bubo, carcinoma; iliac artery rupture following removal of a drainage tube seven days after its insertion at the site of removal of stones from the lower ureter;²⁰ pressure necrosis of the external iliac artery by forceps placed on the internal iliac to control hemorrhage during operation upon these vessels; accidental stab of the vessels in the groin by a child upon flexing the thigh while recovering from an anæsthetic for the performance of circumcision (the knife lying on the sheet with its blade directly over the vessels);²⁶ accidental stab with scissors; these and others too numerous to mention have been the causes of injuries to these vessels.^{6, 16, 19}

Many surgeons have experienced genuine distress under the burden of anxiety for the first few days following treatment of such a wound as this and many have experienced the thrill of seeing the patient recover without gangrene after such a dramatic operation as suture or ligation of these great vessels. Some have had their initial distress followed by the terrible fear that the limb might become gangrenous during the period of observation; and can we picture the agony which must be experienced by a young and ambitious surgeon at seeing his patient bleed to death, or after prevention of this catastrophe, of anticipating loss of limb from gangrene following accidental injury to these great vessels while performing an operation for bubo or hernia?

Along with this lack of practice in the technic of suturing and tying large arteries and veins, the surgeon, when confronted by the management of such an injury, feels also need for clear-cut authoritative information which will lead him to pursue exactly the proper course in dealing with these injuries, often among the most dramatic situations in the practice of surgery. What to do, what not to do and when and how and why, these are the ques-

* Read before the Southern Surgical Association, Dec. 16, 1920.

tions. Disappointment is apt to follow expectation to secure the information necessary to a solution of the problems, from a study of the clinical case reports in literature. The records of laboratory work fail to elicit the completely assembled practical instruction which one needs at his "finger tips" in clear-cut formulated plans of procedure. And finally when one proceeds to a study of the fundamental principles involved in the gross anatomy, histology, embryology and highly organized physiology of blood-vessels in the living human being, he might easily become so engrossed by the fascination of the study that it is quite conceivable for him to fail to see through the penetrating eye of the scientific investigator the broad perspective or "bird's-eye view" of the whole subject for practical application.

Until through the labor of some such combined artist, scientist, and philosopher as W. S. Halsted, all the problems are solved and definite authoritative information becomes available, there is justifiable reason for the publication of isolated case reports describing the exact nature of the lesion, the exact method of treatment, subsequent observations and the ultimate results of individual cases of such injuries.

On the night of August 25, 1920, Dr. W. M. Strickland, responding to a call for the ambulance, found a robust twenty-two-year-old negro man with a pistol bullet wound in the left groin, just below Poupart's ligament at a position corresponding to the location of the femoral vessels. He immediately plugged the wound with a small strip of gauze, placed over it a pad, and with the man's trousers belt buckled snugly over the pad, hurried to the Virginia Hospital, where I saw the patient within ten or fifteen minutes after his arrival. Case No. 20-3579.

Examination showed moderate distention of the superficial veins of the thigh and leg and within an area of ten or twelve inches downward distinct venous pulsation. The arterial pulse of the foot and leg of the injured extremity was not palpable. On the opposite foot it was easily palpable and normal save for a rate of 110 per minute. Within the immediate vicinity and for a short distance above and below the wound, examination detected a rather violent systolic thrill and the characteristic traumatic aneurismal bruit. There was a small-sized area apparently of fluid blood beneath the skin in the immediate vicinity of the wound, but there was no external bleeding, the wound being distinctly of the "dry" variety. The man's general condition was excellent. X-ray examination showed the bullet in the buttock at a level slightly lower than that of entrance. There was no bone injury nor sign of intra-abdominal penetration.

Here then was a case of easily obvious communicating bullet wound of the common femoral artery and vein without external hemorrhage, without hæmatoma and in a healthy young man in a properly equipped hospital. The patient was immediately given $\frac{1}{4}$ grain of morphine sulph. and $\frac{1}{50}$ grain of atropine sulph. and within an hour after being injured the operation was started.

After removal of the external dressing and painting the surrounding skin with tincture of iodine, a clean surgical approach to the iliac



FIG. 1.—Ligation of the external iliac artery and vein above and below a communicating bullet wound of these two vessels.

LIGATION OF EXTERNAL ILIAC ARTERY

vessels well above the site of injury was easily secured through the standard oblique incision for the extraperitoneal ligation of these vessels. Poupart's ligament was cut, the vessels were exposed and two sutures of twenty-day chromicized catgut No. 2 doubled, were placed around the external iliac artery about an inch above the wound and well above the deep epigastric and deep circumflex iliac vessels. These sutures were placed about one-half inch apart in position for instant ligation when necessary. With a good exposure, while Doctor Strickland made pressure on the artery with his fingers, I removed the six or eight inch strip of narrow gauze packing and made a longitudinal incision downward, encircling the ragged wound of entrance. This was excised and a small collection of blood wiped away. There was some welling upward of venous blood from the depths of the wound while looking for the location of the injury. Working gently and carrying the incision downward slowly the wounds in the artery and vein were found to be large, ragged and communicating. The ligatures above were immediately drawn tight. It was too late now to suture, even though the wound had been a suitable one for this procedure. We had "fractured" the artery and crushed its intima. The common femoral artery and vein were then clamped with forceps just above and below the wound and a formal excision of devitalized tissue, including the ragged edges of the vessel wounds, was made. The vessel ends were ligated and the surrounding tissue snugly sutured. The wound was dried, a small piece of soft flat rubber was laid in, and, but for a small place of exit, the skin wound was closed, dressings applied and the entire limb encircled with cotton from the pelvis to the toes. The patient was placed in bed with hot water bottles beside the limb and this heat was supplemented by the heat from an electric light under a tent over the leg. The patient's pulse at the end of the operation was 120. This may have been due to shock, though I was more anxious lest he might have serious dilatation of the heart. On this account and to facilitate whatever benefit the posture might have on the volume of blood in the limb, we elevated the head of the bed. He was also given a few hypodermic injections of one of the preparations of digitalis.

The next day the patient's general condition was excellent; he said he felt the external heat on his toes and foot and the limb was sweating. The second day he and his leg were still in good condition. After darkening the room, we exposed his toes and held behind them a flashlight. The pink color of the toes and nails under this translucency test gave us great comfort. Capillary response to pressure on the nails was prompt. A week after the operation I took the liberty of sticking a pin in his toe to see if it would bleed. It did. Ten days after operation the wound was healed, a few days later the bullet was removed from just beneath the skin on the buttock. External heat was kept applied for two weeks following the operation and a few days later he was allowed out of bed. A few days later he could walk without a limp and exhibited no evidence whatever of any impair-

ment of function of any kind. A month after the operation he was doing ordinary light work and anything else he pleased. Two months after operation he was employed in active work as a combined janitor, butler and chauffeur. December 14, 1920, sixteen weeks after operation, examination fails to detect pulsation of the popliteal or any arteries of the foot. The region of the wound is hard, no evidence of tumor or pulsation is felt, the superficial veins of the foot are conspicuous but apparently normal. There is no difference in the size of the two extremities, the patient has no subjective symptoms of any kind and notices no difference in the sensations or usefulness of the two extremities. There are no differences in temperature, he walks long distances, runs up and down steps rapidly, uses the clutch and handles an automobile with ease, and with the exception of the lack of palpable arterial pulse, his extremity is normal.

DISCUSSION

Should Operation for this Type of Wound be Performed Immediately?

—I still remember having seen, twenty years ago, a man with a large traumatic arteriovenous aneurism, involving the iliac vessels, caused by a bullet wound received many years previously. He travelled about among medical students to exhibit himself as a means of livelihood. He was unable to do hard work; his lower extremity contained huge varicose veins and was greatly increased in size. Matas' contribution to this Association last year,^{11, 12} in which he reported numbers of cases of communicating wounds between arteries and veins operated upon at varying periods of from six weeks to fifteen years following injury, the case reported by Caldwell several years ago of injury to the subclavian artery operated upon ten days after injury, these and many other reports come quickly to one's memory. Certainly with these facts clearly before us and with a man losing no blood externally and with no hæmatoma, it would not have been easy to have said that the man here reported would have died if he had not been operated upon immediately.

It can, therefore, scarcely be claimed that immediate operation within the first few hours is urgently called for to save either life or limb in cases of bullet or stab inflicted communicating wounds of large arteries and veins, without external hemorrhage and without large hæmatoma. The large number of cases of arteriovenous aneurism in literature and the many recorded cases of war wounds successfully transported to distant hospitals, successfully controvert such a contention. These remarks, of course, did not have reference to those wounds accidentally inflicted by the operating surgeon and over which he has immediate control. But when an individual is shot or stabbed in these vessels it can scarcely be doubted that if he can survive long enough to be placed in a hospital and prepared for operation, he is not likely to die of hemorrhage *per se*, even though an operation is not performed. On the other hand a vessel wound bleeding so furiously as to demand immediate formal operation would be fatal

before the anæsthetic could be administered and sterile linen and instruments arranged.

No argument is necessary to contend that unclean forceps, ligatures, packing or any such method of procedure should not be employed upon vessels in the depths of a ragged contaminated wound. The fact that these procedures are so likely to be followed by sepsis, by secondary hemorrhage and greatly increased liability of gangrene, supports the belief that even if it is demonstrable that patients do not always die of such wounds, even though not operated upon immediately, the dangers of infection, large hemorrhage and hæmatoma formation with the liability of gangrene due to thrombosis and pressure upon collateral arteries, constitute indications for reasonably prompt action. If in any case long delay is justifiable it must be in case of a clean-cut "dry" wound, bleeding from which may be adequately controlled by moderate pressure.

Acute dilatation of the heart is an immediate danger, the mechanism of which is easily comprehended when it is remembered that normally all the blood which should come into the limb is diverted hurriedly back to the heart. In young, healthy individuals acute dilatation may be survived; in individuals of middle age and especially with cardiac degeneration, death from acute dilatation of the heart may ensue promptly.

The studies of Halsted, of Callander, of Matas and many others clearly demonstrate that there are many real dangers to the life and limb of the patient from these lesions. Extensive proximal dilatation of the artery entails all the dangers of an arterial aneurism including the subsequent development of gangrene, and in addition Halsted^{15, 17} has conclusively shown that secondary dilatation of the heart is a part of the pathology of an arteriovenous fistula.

Is Deliberate Delay for the Purpose of Permitting the Establishment of Collateral Circulation a Well-founded Practice? Is there a physiologic or anatomic reason for this belief? On the contrary is there not much reason for believing that the development of circulation is antagonized by arteriovenous fistula? Many cases of arteriovenous aneurism have apparently caused gangrene partly by the pressure of the sac on the surrounding vessels, partly by infection and partly by arterial thrombosis. Certainly it is amply demonstrated that the normal quantity of arterial blood does not go to the distal portion, and this is necessarily followed by diminished arterial calibre followed by vessel hypoplasia. As a matter of fact, sufficient knowledge of the physiology and anatomy of the arteries and veins has already been acquired to demonstrate that there can be no advantage in delaying operation with the idea of establishing the new route of circulation. Is it not true that the most certain way to secure circulation in those areas where it is possible to secure it, is to put upon the tissues the necessity for it? It is tissue needs which cause the formation of new vessels and the enlargement of vessels already present and tissue needs which cause the vessels to function. The researches of physiologists and embryologists leave no room for doubt of this fundamental law of biology.

We are, therefore, compelled to subscribe to the belief that for many reasons operation should be performed within a reasonably early length of time following the receipt of the injury, but that it is usually quite proper and often quite wise to delay operation for a few hours or even days to secure the services of a qualified surgeon, a properly equipped hospital and a clean field of operation. To estimate in practical terms the most suitable time for the performance of operations for contaminated and infected wounds implies a comprehension of the three stages of all infected wounds: the stage of contamination, the stage of infection, the stage of inflammation. It must be uniformly agreed that prompt excision of all devitalized tissue (*débridement*) should be performed as early as possible and with the greatest efficiency within at least twelve hours (the stage of contamination) and the operative wound completely closed as a clean wound. If performed after twelve hours (the stage of infection) the diminished efficiency of *débridement* is demonstrated by the frequency with which the wounds must be reopened and disinfected. Operation performed after thirty-six or forty-eight hours implies almost certainly the treatment of the wound for inflammation; and it is no longer open to doubt that inflammation of a wounded blood-vessel is the greatest danger to which it is liable. It is inflammation that results in thrombosis; inflammation that is followed by secondary hemorrhage; inflammation that causes gangrene. Pyæmia secondary to phlebitis constitutes a grave situation. Vascular wounds not operated upon within the first thirty-six or forty-eight hours and in which inflammation does not occur, may be operated upon for arteriovenous aneurism quite successfully at one's leisure.

What is the Exact Status of the Preliminary Tests for Collateral Circulation in Influencing the Treatment of the Injury to a Large Blood-Vessel?—Are the tests reliable indications, always applicable, and in case the tests are negative is it advantageous to delay action? To observe the downward flush after pressure upon the artery above the injury and accurately time its appearance is obviously not easy to do in negroes, for the flush can only be seen in the nails, the bottom of the feet and between the toes. It is quite obvious that even in white people there is considerable room for error in applying this test and much is dependent upon the adequacy of the light in which the test is made, the condition of the eyesight of the observer and other factors.

A prick of the toes or feet with a large-sized needle or small knife to produce bleeding would also be subject to some margin of error, for if there is a fistulous communication between the artery and the vein the veins even of the foot are slightly distended and bleed, and even in the absence of this a moderate amount of residual blood in the capillaries might lead one to a mistaken conclusion. Even though a justifiably deep puncture fails to cause a satisfactory amount of bleeding, does this justify a positive prognosis of gangrene?

A comparison of the surface temperature of the wounded extremity

below the seat of injury is attended by considerably more chance of inaccuracy than is the case in the clinical use of the axillary temperature in the ordinary routine estimates of the body temperature, and we can easily conceive that after a bullet or stab wound involving a large vessel in the groin, the patient might be the victim of cold feet on both sides.

Palpation of the peripheral arterial pulse to determine what the condition of the circulation will be tomorrow or the next day is notoriously deficient in giving accurate information. Surgeons have known for years that frequently after injuries in the region of an artery in which the artery itself is not cut, there is a temporary obliteration of the pulse in the arteries distal to the injury, and this is not conclusive evidence that the circulation is totally or permanently cut off. The recent observations of Leriche, and for many years by Halsted,^{17, 18} that spastic contraction of the artery at a point distal to the location of the trauma incident to handling large blood-vessels, are explainable as a result of irritation of the periarterial sympathetic nerves. Matas has observed temporary obliteration of the pulse distal to aneurism in cases which at operation showed a patulous lumen of the artery throughout.¹³

We have not seen records in the literature in which surgeons gave up hope of restoring the circulation and performed amputation solely because the pulse in the artery distal to the point of operation failed to appear in the first few hours or even days following operation. There are many cases recorded in which the peripheral arterial pulse was days or even weeks in appearing and yet no gangrene occurred. In the case herein reported, the pulse in the popliteal and vessels of the foot are not palpable for months after ligation and there is no sign of ischæmia. It seems that failure of the test of collateral circulation by this means would hardly lead the average surgeon to fail to give his patient the benefit of whatever results might accrue from operations upon the blood-vessels before proceeding to amputate. At the present time, however, can it be said that operations upon blood-vessels should ever be postponed or abandoned because of the negative test of collateral circulation or should the type of operation be determined by these tests?

When, however, the extremity is cold and pulseless and especially if it is insensitive to pain or immobile as the result of extensive injury involving the main arterial trunk of many hours' duration and complicated by extensive bone and joint injury, which are either certainly or almost certainly the seat of extensive infection, it would seem to be standard practice to perform amputation at once.

A question of great practical importance in dealing with injuries of large arteries concerns the exact location for the incision. One may assume now that in dealing with any wound in which infection is present the seat of operation should be reached through clean healthy tissue, the surgical approach. For control of the circulation during operation upon injured arteries this implies that the incision should be made through uncontaminated skin and tissue at

a reasonable distance proximocardial to the wound. Gentle pressure over the wound prevents hemorrhage incident to a clean approach to the vessels. When the vessels are exposed the next question involves temporary control of circulation by the use of clamps or ligatures. Digital pressure may be reliable enough but fingers occupy much space and are more useful for other purposes. Various clamps have been of great use while operating upon the femoral, popliteal and the axillary arteries; but do they possess sufficient advantage over the usual silk, catgut or tape ligature in the case of the external iliac which is quite deeply imbedded, intimately adherent to its surrounding sheath and the muscles and fascia in this location? Is it wise to disinter this deeply placed vessel to the extent necessary to employ clamps or had the circulation better be controlled by means of ligatures, which can be adequately placed while the vessels remain in situ without denudation and without traction and disturbance of the surrounding tissues? After the temporary ligatures have been placed and the circulation adequately controlled, it seems quite fair to assume that all the wounded tissue in the region, inclusive of the ragged edges of the wound of the vessels, should be cleanly and adequately excised by sharp knife dissection. With the well-known dangers of infected blood-vessels, such as secondary hemorrhage and clot formation, it would seem that excision of devitalized tissue should be complete, even though it may be necessary to excise as much as to result in a resection of the vessels involved. There is ample ground for the belief that all cases of thrombosis are due to infection, and without infection, even in vessels of small calibre, thrombosis does not occur following either a proper suture or total occlusive ligation. There is further reason to believe that in the absence of infection, gangrene is never caused solely by ligation of any part of the external iliac or femoral at a point above its communication with the sciatic through the branches of the profunda femoris.

The next question which presents itself when one is forced to ligate the iliac above its deep epigastric and circumflex iliac branches is: should these branches also be ligated? In dealing with arteriovenous aneurism of long standing or with a lesion from a recent wound of the vessels, and in dealing with ordinary aneurism of the artery itself, Halsted's teaching, based upon the sound reason, which this eminent surgeon always has for everything, gives us ample reason for ligating these vessels when for aneurism the parent trunk is ligated above and below. The branches of the external iliac were not deliberately ligated in the case herewith reported. The pulsation in both these vessels was seen before the external iliac was ligated and it was not detected after the ligatures were made tight.

The next question after adequate *débridement* has been performed and the wound is clean, involves whether *to suture or ligate the vessels*. In this case more than half the vessel walls were destroyed by the wound and lateral suture would have been, in my judgment, impracticable. End-to-end anastomosis would have been possible both of the artery and of the vein. A defect of slightly more than an inch would have had to be bridged over

by traction upon the ends of the arteries or by grafting a segment of vein between the arterial ends. Realizing my own limitations, I felt much chagrined that I was not sufficiently skilful to make a successful end-to-end anastomosis.

The practical point, however, still to be determined in dealing with wounds of the femoral artery and vein involves this very question. There is reasonable doubt of the preference over quadruple ligation and extirpation, of end-to-end anastomosis, or vein graft for repair of a defect in the common femoral artery necessitating extensive disinterment of the artery and freeing it from its bed for a sufficient extent to bring the ends into apposition without tension. Such extensive freeing of the ends of divided nerves is quite proper, but is it safe to employ the same practice in dealing with divided arteries?

Summing up the evidence as I am able to interpret it from the experimental work and clinical observations, there is basis for the belief that end-to-end anastomosis and vein graft may be preferable in the popliteal following ligation of which gangrene is not uncommon, but in the case of the external iliac or common femoral it remains to be proven that quadruple ligation and extirpation in the absence of infection is ever followed by gangrene.

The literature on the subject is too full of uninterrupted recoveries following ligation of these vessels in cases in which wound infection could take no part; and gangrene following ligation is so rare even in cases in which infection was present, that it is not easy for one to believe that either vein graft or disinterment for relief of tension preliminary to end-to-end anastomosis can be preferable.

It is definitely proven that aseptic ligation is *not* followed by thrombosis.^{16, 17} It cannot be questioned that skilful suture is often followed by thrombosis. No one can predict if thrombosis does occur how long the thrombus may be; and a long thrombus extending up and down the lumen to branches may defeat the purpose of suture and result in gangrene. Surgeons have opened the external iliac artery deliberately and removed clots to prevent or cure incipient gangrene. Leakage through suture holes can be detected only after completion of suture and removal of temporary occlusion. Any case of sutured vessel from which leakage occurs is extremely likely to be followed by thrombosis and may be the cause of perivascular hæmatoma with all the pernicious effects of hæmatoma formation in favoring inflammation and causing pressure upon the main vessel and other arteries (potent factors in causing gangrene). The clinical, the experimental, and the logical evidence at the present moment certainly offers much support to the belief that for arterio-venous fistula involving the common femoral or external iliac vessels occlusive quadruple ligation of artery and vein with extirpation of the lesion through an incision giving a clean surgical approach to the field of operation is quite preferable to the most expert suture of the vessels through damaged and contaminated if not infected tissue.

And finally the question arises *when it becomes necessary to ligate an artery should the corresponding vein also be ligated even though it is not*

injured? This question, of course, does not enter into the case here reported because the vein was also extensively injured. French surgeons and Makens, of England,^{5, 18} advocate simultaneous ligation of the vein when it is necessary to ligate the artery even though the vein is not injured. Lee,¹⁴ however, working at the American hospital at Neuilly, reports eight consecutive cases of ligation of the femoral artery alone in Hunter's canal for popliteal injury and all the cases were successful. Neuhoﬀ and St. John¹⁰ believe the vein should be ligated to prevent phlebitis, and state that it is definitely determined that after vein ligation there is less danger of gangrene. Surely every surgeon would agree now that in case of injury of the femoral artery and vein no effort should be made to preserve the lumen of the vein. Halsted¹⁸ quotes the investigation of Drummond upon this subject in the case of the vessels in the viscera and refers to the work of Welch and Mall on "intestinal infarction" (soon to be published). Bowel strangulation by ligature of the artery only, invariably shows more serious change than after simultaneous ligation of both artery and vein. At Halsted's¹⁸ suggestion Hooker made some interesting observations upon the blood-pressure in the branches of the femoral artery. After ligation of the artery alone there was an immediate fall of pressure from 114 to 20 mm. Within an hour's time the pressure rose to about 50 mm. (Was this the result of dilatation due to periarterial sympathetic paralysis?) When pressure was made upon the main venous trunk there occurred an immediate rise of pressure in the artery sometimes as much as 20 mm. of mercury. The test for several hours gave uniformly similar results.

Halsted¹⁸ states: "We are compelled, I believe, to subscribe to the view that some degree of equilibrium of the arterial and venous systems must be maintained. Granting this, there vanishes any difficulty that there may have been in accounting for the very high percentages of gangrene observed to follow ligation of the artery in cases of arteriovenous fistula. There is in these cases not only a great enlargement of the venous bed but also a curtailment of the arterial tubage—a shrinkage or hypoplasia of the arteries distal to the fistula. Thus even before the artery is ligated the limb is handicapped by this lack of balance. When, now, the artery above a fistula is tied, irrigation with arterial blood is suppressed on one side of the capillary bed and on the other side of it the mixed blood is deprived of a share of the pressure by virtue of which the life of the limb was partly sustained. It seems permissible to conjecture that in some instances the limb distal to the fistula may have been hardly less dependent on the pressure from the venous than from the arterial side, and if so we can more readily comprehend the ensuing gangrene than the frequent absence of it after ligation of the fistuled artery."

The clinical observations made especially by the English and French surgeons during the war⁵ that after ligation of the large arterial trunk in the extremity, gangrene was less likely to result if the companion vein was also ligated, is easily explained by the demonstration of Hooker that catabolic substances such as are contained in the venous blood cause dilatation of the capillary bed. Though, of course, highly toxic substances permanently re-

tained would be undesirable, the great abundance and interinosculature of veins in the extremities makes it quite impossible to retain venous blood for a great length of time by ligation of even the largest vein. The common-sense suggestion occurs that if the blood entering the limb is diminished or cut off entirely, we should at least be sufficiently considerate of the tissues to tie the vein and permit what will of the blood surely containing some food to remain. There is genuine reason for believing that vein ligation favors the development of collateral vessels, and through retention of blood volume and pressure aids enlargement of vessels already present.

As to material, silk, catgut, fascia or linen tape, we are not able to get from recorded cases definite and positive proof of the best by test. In the case here recorded we used chromic catgut No. 2 doubled, and though I know of no reason to regret it in this case, I shall, if I have to deal with a similar injury again, follow Halsted's advice and employ coarse silk.

I wish in this case we had more completely extirpated the injured portion of the vessels. Callander's cases¹⁹ of recorded arteriovenous aneurism show 100 per cent. of efficiency of this method of treatment. In the case herein reported we accomplished almost complete extirpation of the vessel walls between ligatures through *débridement*.

In this case we placed in the wound for three days a strip of flat rubber to provide exit for possible oozing. There should be no possibility of post-operative oozing in any case of blood-vessel surgery—the wound should be completely closed, perfectly dry, and the dressing applied in such a manner as to secure complete immobilization for a few days. Packing and pressure are pernicious practices.

Observations made upon injured blood-vessels have added much of practical value to the study of physiology of the circulation and will explain many phenomena which have been commonly observed and heretofore unexplainable. Wounds of large arteries are invariably followed, at least for a few hours, by contraction of the artery for some distance below the wound and cessation of pulsation. This might account for the clinical observation that frequently with wounds even of some size in a large arterial trunk, there may be no bleeding for several hours. In wounds of large arteries, even independent of arteriovenous fistula, bleeding is often so small in quantity that the war surgeons spoke of them as "dry wounds" of arteries. It has also been a common observation, both by experimentalists and surgeons operating upon blood-vessels in human beings, that during the manipulations of an artery incident to operation, the vessel for a considerable distance, if not throughout its entire extent below, becomes contracted down to perhaps half of its original size. Following this period of contraction, after several hours there occurs dilatation, during which there will be increased flow of blood into the artery, as shown by various instruments for detecting blood-pressure and temperature. Preliminary contraction and reactionary dilatation are readily explainable upon the effect of irritation and destruction of the periarterial sympathetic nerves. Irritation of these gives contraction; destruction results in

dilatation or vasomotor paresis. Dilatation of the capillaries preceded by preliminary contraction invariably occurs when the vasomotor nerves of the arterial trunk or of the capillaries are destroyed. The capillary bed, when dilated by vasomotor paralysis or by toxic substances in the blood, favors blood retention and thus tends to keep open and full of blood the capillary spaces for tissue nutrition.

The significance of the periarterial sympathetic nerve-fibres may prove useful to explain certain phenomena referable to the symptoms and signs produced by arterial injuries and may have a wide influence in determining the time for and method of operative treatment. W. S. Halsted¹⁸ has exhibited interest in this subject and will doubtless eventually give us much specific information. Injury to the wall of the arteries seems invariably to be followed by spastic contraction of the artery for a variable distance peripherally. This may account for the fact often observed that wounds of large arteries often remain "dry" for six or eight hours. During this period of arterial contraction at which time the distal pulse is obliterated by spasm there is liability to error in believing that the artery is occluded and the extremity in danger of gangrene. Following the period of spastic contraction there occurs wide arterial and capillary dilatation with hyperæmia of the part, increased local temperature and other reactionary phenomena. From these facts would it not seem quite wise in dry wounds of arteries to wait for the subsidence of contraction from periarterial sympathetic nerve irritation before operation for such an injury? There are other causes for dry wounds of arteries and veins. The blood may flow from the artery directly into the vein and consequently not escape in the form of systemic hemorrhage. The patient bleeds into his own vein, the tissues distal to the injury are ischæmic. Wounds may be dry, therefore, though this constitutes no positive evidence that the artery has not been injured. The peripheral pulse may be entirely obliterated, and this is not positive evidence that the lumen of the artery is occluded, or that the vessel is completely severed. Both these phenomena may be due to periarterial sympathetic irritation.

These phenomena may account for many cases recorded in literature in which, on account of failure to detect the pulse in the feet and hands, it was assumed that the artery was blocked by thrombus. Pulseless and cold hands and feet may not necessarily, therefore, be regarded as doomed to gangrene. Failure of return of the peripheral pulse within a period of eight hours after injury or operation constitutes no reason for grave anxiety. Later than this the presence of vascular dilatation due to paresis of the vasomotor mechanism will be of great service in aiding the establishment of circulation. Is it probable that the paralytic vasomotor dilatation may be more complete when the main arterial trunk is boldly ligated and excised than when it is more carefully handled as of necessity it must be for successful suture?

Reading the clinical reports of cases of injury to blood-vessels, one is impressed by the great variability of the character of observations made. There are many records of injury to the femoral and popliteal arteries fol-

lowed immediately by absence of pulsation in the dorsalis pedis or of one of the tibial arteries for a few hours following injury, and later a return of pulsation and circulation perhaps independent of any operation or any treatment. The special importance of the knowledge of this effect of arterial sympathetic irritation and destruction has to do with certain of our interpretations with reference especially to the testing of collateral circulation before operation and of the assumption which we are likely to make that this natural subsidence of arterial contraction resulting in dilatation and restoration of the pulse wave is a result of treatment. It is conceivable that the return of the pulse in the dorsalis pedis might follow ligation of some artery in the region of a large trunk like the iliac or femoral, and which during the surgeon's distress at the sight of such a hemorrhage, he may have thought was the large vessel itself. Suppose, for example, during an operation for hernia an amateur surgeon should cut one of the epigastric or circumflex iliac branches of the great arterial trunk, he would be excusable if during the stress of the situation, the volume of blood looked like enough to have come from the femoral, and then immediately after tying the smaller artery, though perhaps with some trauma to the parent trunk, he should find an hour or so later that the pulse in the dorsalis pedis was not palpable, it would not necessarily follow that he had tied the femoral artery. Moreover, a return of pulsation in the foot and ankle arteries as promptly as a few hours after the ligation would not necessarily indicate the establishment of collateral circulation. If looked at critically, such phenomena would lead one to believe that it was not the femoral but some other artery which had been ligated. A few hours is ample for the return of pulsation coincident upon the reactionary dilatation following periarterial sympathetic irritation, but it is not possible to reestablish collateral circulation sufficient to cause pulsation of the dorsalis pedis within a few hours after ligation of the common femoral. In the case herewith recorded pulsation of the vessels in the foot, nor even of the popliteal, can be detected, and it has been six months since the iliac was ligated. There is abundance of blood in the limb, the superficial veins are full, though not markedly distended, and the patient knows no difference in the sensations and usefulness of the injured from those in the uninjured extremity.

Collateral Circulation.—Next to the saving of life through the prevention of hemorrhage, one has hopes of saving the limb through the prevention of gangrene. If the external iliac artery is deliberately ligated, or if following suture it becomes accidentally occluded by clot formation, will the tissues in the limb distal to the point of occlusion receive nutrition, and if so how? Authors speak of collateral circulation through anastomosis of arteries. They say that after ligation of the external iliac artery the collateral circulation is carried on by anastomosis of the branches above the point of ligation of the main artery with the branches of the parent trunk below the point of occlusion. From these statements we are led to believe that the branches of the artery above actually become united to and communicate with the branches of the arteries below. Does this mean that the blood passes directly from the distal

end of an artery above into the distal end of an artery below and then pursues its course in reversal to the normal physiologic course of blood in arteries back to the parent trunk? Diagrams illustrating this method of connecting up arteries and reversal of arterial circulation are pictured in many text-books. Must we believe in such a distortion of normal physiology? It has been repeatedly demonstrated by Horsley,^{21, 22} Stetten⁸ and other investigators that reversal of circulation of blood from arteries to veins does not occur. It does not seem reasonable for us to believe that blood can pass from one artery through the capillaries back into the arterial capillaries and then in a reverse direction through another artery. This question might be answered by experiments in a living animal, although I can find no record of it having been done. On the other hand, it is quite demonstrable that those arteries constituting the posterior branches of the aorta do actually communicate with arteries having a location anteriorly, and this union results in forming arterial loops. Illustrations of this loop formation are noted in many places. The posterior intercostals actually communicate with the anterior intercostals, and when an intercostal is cut bleeding occurs from both ends. Such a vascular loop is also formed by the right and left gastroepiploic artery on the greater curvature of the stomach, and with the uterine and ovarian artery forming the arterial loop of Byron Robinson, and is the method of formation of arterial arches in the feet and hands. Arteries communicating with arteries results in formation of vascular loops around the bowel, is seen on the outer aspect of the dura mater, and is the actual cause of the formation of the circle of Willis.

It is well known that the ligation of one internal iliac artery will not curtail the amount of blood going to the uterus and other organs supplied by these vessels. This is clinical evidence of the probable existence of arterial loop formation by the terminal junction of the uterine arteries. When it is remembered that the internal iliacs are the continuation of the common iliacs and that these are homologous with the lumbar and intercostal arteries, this loop formation by inosculation is exactly what we would expect. The disappointment caused by failure of ligation of both internal iliacs and both ovarian arteries to cause starvation of uterine cancer is incident to the fact that this organ receives blood also from branches coming from the external iliac and inferior mesenteric arteries and other sources. To strangulate the stomach by ligation of the coeliac axis or the small bowel by ligation or thrombosis of the superior mesenteric is easy enough. These arteries, the sole source of blood to the parts supplied, are anterior branches of the aorta. But to produce total ischaemia by single ligation of a dorsal segmental branch of the aorta is a different proposition because of the normal inosculation of these with each other through communicating branches of the arteries of different segments and because of their communication with their own anterior portions. The posterior branches of the dorsal intercostals and lumbar communicate above and below the point of total occlusion of the abdominal aorta. The reason for efficient circulation through the communication of the superior epigastric from

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above and the inferior epigastric from below is easily comprehended. These vessels represent essentially the terminations of dorsal segmental branches of the aorta in embryo; the superior epigastric from the internal mammary (a branch of the subclavian homologous with the posterior intercostals) and the inferior epigastric from the external branch of the common iliac (a greatly enlarged lumbar artery). Both epigastrics, therefore, represent terminations of dorsal segmental branches of the aorta; the superior from the subclavian and the inferior from the common iliac.

With clear-cut distinction of meaning we may, therefore, quite properly speak of inosculation of arteries, by which we mean the terminal ends of two arteries actually communicate forming a loop, and an anastomosis of arteries, by which we understand that terminal branches of various arteries in a given region of the body come intimately in contact with each other, and to the naked eye appear to mix, but in which no blood actually passes from one artery into the other.

It is quite obvious that the large amount of blood brought to various organs and tissues by the abundance of smaller branches from different arterial trunks is adequate to maintain nutritional needs. This fact is demonstrated in every operation where ligatures are employed to check hemorrhage; and by the total failure of so-called "starvation methods" of treating cancer by ligation of incoming vessels. Genuine skepticism concerning the utility of ligation of thyroid arteries for the purpose of diminishing the amount of blood coming to the thyroid gland is well supported by so firm a foundation of elementary anatomy and physiology.

On the other hand, the sudden occlusion of a large artery like the femoral or axillary in cases of great peripheral engorgement due to elephantiasis, or venous blocking by cancer adhesions, may cause temporarily some relief of swelling by temporarily curtailing the amount of inflow; and ligation of both external carotids has likewise caused temporary cessation of pulsation of cir-soid aneurism of the scalp.

A true compensatory collateral circulation implies a compensatory enlargement of the normal inosculation of arteries forming a communicating loop when the necessity for this performance is brought about through the imposition of additional function after ligation of one artery forming a part of the loop. Is it true, however, that in parts of the body where such loops are not formed normally, their formation can be brought about by ligation?

It seems that fundamental considerations of normal anatomy would go far toward giving us a satisfactory explanation for the repeatedly observed clinical fact that gangrene should never occur after a single ligation of the aorta or common iliac or internal iliac; that it will never occur after ligation of only one of the arteries forming the arches in the feet and hands, nor of the intercostals nor of certain other vessels having such a normal communication with each other by inosculation. The clinical observation that gangrene frequently occurs after ligation of the popliteal artery is explainable when we remember that there is often no companion artery with which the popliteal or its branches

can communicate through inosculation. But for the persistence of a patulous portion of the primitive popliteal, anterior to the popliteus muscle (its embryonic location) and the possibility of establishing communication between this and one of the tibials or peroneal below, total ischæmia might always result from occlusion of the popliteal.

The explanation of the method of formation of collateral arteries must of fundamental necessity take into consideration the original mode of formation of these vessels in embryo; and of the part played by the physiology of these structures in relation to their formation; and of the physiology of blood-vessels in adults. In this way we may find it possible to explain certain clinically unexplainable phenomena and aid may be secured in the explanation of certain phenomena at the present time constituting obscure problems incident to blood-vessel surgery. This constitutes a large field for speculation, and some philosophical mind like that of W. S. Halsted should be able to put together the various scientific facts and give us a basis upon which to act intelligently in the practice of clinical surgery.

The origin of blood-vessels in embryo is independent of the origin of the heart. The first blood-vessels in embryo are formed in the periphery and actually antedate in point of time the appearance of the embryonic heart. The origin of blood-vessels constitutes no exception to the fundamental biologic laws enunciated by Roux, Thoma and others that they are the product of tissue needs.^{3, 4} In other words function fixes form; physiology is the cause of anatomy. Capillaries are the product of specific cells designated "angioblasts." The capillaries are not formed as a result of the blood-stream; they antedate the stream stage of the circulation. The development of capillaries is in response to tissue needs for the passage of food and effete material. After, however, the formation of the heart and the communication is established by capillaries with the arteries and veins, the further development of these structures is markedly influenced by the volume of blood, perhaps the blood-pressure and by the function of the vessels in effecting the transportation and interchange of nutritional and effete material to and from the tissue cells. To facilitate this function there must of necessity develop a complicated physiologic mechanism.

As factors in the dynamics of the circulation Hooker³⁰ has clearly demonstrated the great importance of capillaries and venules. The findings of this physiologist are of great practical importance in explanation of the development of collateral branches or the substitution of function of one artery for another when one becomes occluded and in demonstrating the chemical and nervous mechanism controlling the dynamic influences of the capillary bed. He has shown that oxygen, adrenalin and other food substances cause contraction, while CO², lactic acid, histamine, and other catabolic substances cause great dilatation of the capillaries. Of great importance was his remarkable observation that after the death of the animal there regularly occurs alternate contraction and dilatation of the capillaries, reciprocally with the venules. In this way blood was passed from capillaries into venules and from venules

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back into capillaries. But not in a single instance was the blood observed to be carried from the capillaries into an arteriole. The capillary constriction was seen to sweep blood in a peristaltic fashion from the capillaries into the venules during a period of fifteen minutes or more, after which a remarkable relaxation of the venous side occurs, the capillaries again becoming filled by blood flowing from the venules; this stage lasts forty-five minutes or more. Finally, coincidentally with rigor mortis, capillary contraction occurs and they remain empty. This is the beginning of gangrene. These remarkable phenomena were shown to be controlled by chemical substances and a nervous mechanism and constitute the major process by which extensive capillary areas may be emptied and packed with blood and plasma passed into and out of the tissue spaces.

Further observation illustrated the difference between the behavior of capillaries related to arteries which communicate directly with each other through inosculation. After ligation of the carotid artery and the vessels of the omentum, preliminary contraction did occur. Hooker's explanation of the capillary contraction is that it results from asphyxia. Asphyxia does not occur in tissues supplied by arteries which actually inosculate with each other unless all the arteries involved are tied. In other arteries the branches of which do not inosculate but merely anastomose, ligation is ample cause for asphyxia. The physiologic needs of the cells distal to ligation take active part in causing the remaining arteries to bring more blood and causing both the increased calibre of already existing arterial branches and the formation of new branches adjacent to the point of arterial occlusion. And finally of great importance in its bearing upon occlusion of arteries is the fact that tissue needs may result in reestablishment of function and of patency to arteries which, though atrophic and hypoplastic in post-natal life, played a great part in physiologic action and were arteries of large size in the period of development. The application of this fact to the problems of the route of blood transportation after ligation of the femoral or external iliac artery would lead us to predict with a belief close to certainty that the circulation would be brought about through the reestablishment of communication through the sciatic artery and its inosculation with the deep femoral through the perforating branches. This area of arterial inosculation is developed from Senior's ² plexus of communication between these vessels in embryo.

The researches of Senior ^{1, 2} published in 1919-1920 upon the embryology of the arteries of the lower extremity have resulted in the discovery of facts of great value in their practical application to the question of the mode of rerouting blood circulation or of the substitution of function of one artery when as a result of ligation another artery is rendered functionless.

The work of Senior ^{1, 2} and of Hooker ³⁰ when studied together are capable of throwing much light on the explanation of the maintenance of circulation in the area distal to the application of the ligature. And it will be interesting when the reports of vessel ligation are tabulated, to note the conformity of results obtained in practice, with those which could have been anticipated

through a comprehension of the origin, development and function of the blood-vessels and the application to clinical surgery of the basic laws of biology.

It has been known for many years that in early embryonic life the arterial supply to the lower extremity was through an artery called the axial, the uppermost remains of which in the adult, is the sciatic. The external iliac-femoral artery does not exist in the earlier stages of embryonic life, but is a later development from the embryonic umbilical artery which in the mature foetus is the common iliac. Though the deep epigastric artery is apparently a branch of the external iliac, there are evidences of formation of the epigastric at the earlier period in the life of the embryo than of the formation of the external iliac. Somewhat later the common femoral divides into two terminal branches, one of which, the saphenous, becomes the superficial femoral, the other persists as the profunda femoris. The femoral artery, therefore, though a later product than the primitive sciatic, grows with much greater rapidity and to a much larger size.

Almost coincident with the division of the primitive femoral into its two branches, there develops from the primitive sciatic which at this stage of the embryo is called the ischiadic portion of the axial artery (reaching all the way down the extremity to its terminal plexus in the foot) a recurrent branch called the rami communicantes. This grows upward toward the developing femoral and ends in a distinct plexus called by Senior the rete femorales. In this collection of terminal arterial capillaries at least a portion of the blood-stream passes directly through this communicating plexus of Senior to and from the femoral and the axial arteries, though a part of the blood is also drained to the venules in the usual way.

In the embryo Senior ² has shown that the plexiform arrangement between the terminal branches of the rami communicantes from the axial and the terminal portion of the femoral actually exists. He has not been able, however, to demonstrate such a plexus arrangement in any other portion of the lower extremity except the portion of the artery ending in the foot and which represents ultimately the arch formations. Even around the knee he was unable to demonstrate this plexiform arrangement. The plexuses, however, are certainly demonstrable in the region of the communication between the sciatic and the femoral.

As the femoral grows downward it comes in contact with the axial and seems to take possession of this vessel. Passing on downward the portion of the axial just above the communication with the femoral becomes smaller and ultimately is indistinct. The upper portion remains as the adult sciatic. The portion of the axial below the connection with the growing femoral remains and is represented by the popliteal. This divides in the process of development of the leg into three adult arteries, the anterior and posterior tibial and the peroneal. Thus it is clear from the standpoint of embryology that in the upper part of the thigh there are two main arterial trunks, the external iliac-femoral and the sciatic; in the region of the knee the popliteal is the sole arterial supply and below this there are three vessels. It would

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follow from this that the most dangerous vessel in the lower extremity for ligation, so far as future blood supply is concerned, is the popliteal; and this conforms to clinical experience.

In the early embryo the part of the axial remaining as the popliteal is located anterior to the popliteus muscle. As a result of the development of this muscle, the popliteal artery becomes posterior to the muscle, though with some frequency the primitive popliteal remains as a patulous branch located between the muscle and the knee-joint and gives rise to the anomaly of a double or accessory popliteal artery. Can it be that this anomaly can account for the fact that gangrene does not result from every case of ligation of the popliteal artery?

Are we justified in the belief, therefore, that the collateral circulation brought about by the ligation of a large arterial trunk occurs in a simple unphysiologic method by which it is described by most authors, or must we readjust our views to conform to the laws of development which operate in the embryo and are obeyed when the functional necessity for such blood circulation is brought about artificially either through surgical ligation, accidental injury, or arterial thrombosis?

There is opportunity for some qualified and equipped investigator to make an experimental study of this question. We will predict that biologic laws will be obeyed and that after ligation the circulation of the blood reverts to the vessels through which it circulated in embryo. The function of the common femoral, or external iliac artery when this vessel is tied, may reasonably be expected to be taken by the sciatic, provided, of course, the arteries and the individual are not as ancient as to be incapable of taking on additional function and performing extra laborious work. If any case of gangrene has ever been conclusively shown to be the result of aseptic ligation solely of the common femoral or external iliac vessels on account of a wound of even moderate recency, the case report is not easily accessible.

A remarkable case reported by Neuhoff and St. John¹⁰ records the following ligations after an extensive war injury of the thigh. The femoral artery had been ligated immediately; following this, as a result of infection, there were eleven hemorrhages; on the twenty-third day the femoral vein was ligated; and on the thirty-fourth day the external circumflex (?) was ligated and on the same day the femoral artery was re-ligated; on the fiftieth day the profunda femoris (?) was ligated; on the eightieth day the profunda femoris (?) was re-ligated; and finally through a clean surgical approach the external iliac artery was ligated, and five weeks later the wound was healed without gangrene and the patient was discharged as out of all danger of gangrene and with cure of the infection.

It will be noted that the report does not state with absolute certainty that the profunda femoris was ligated; it was thought to have been done twice, once on the fiftieth day and once on the eightieth day. It is quite certain that the sciatic and its parent trunk, the internal iliac, were not occluded. This case is instructive. There is room for speculation. Did the interval of at

least forty-five days before the first ligation of the profunda femoris and of thirty-four days before the second ligation of this vessel permit the collateral circulation through the sciatic to become well established? It will also be noted that on the twenty-third day a large vein, "probably the femoral," was ligated. Was this also influential in prevention of gangrene?

The case is a remarkable demonstration not only of the effects of infection in causing secondary hemorrhage and of the immediately satisfactory result of ligation of the external iliac artery through a separate incision through non-contaminated tissue, the "surgical approach," but goes a long way toward illustrating clinically what we would expect biologically: that after occlusion of the external iliac the blood reaches the periphery through the same vessel it did in embryo, the sciatic artery. Will not some one make experimental test of this theory and determine whether or not, in response to functional needs, the sciatic-femoral communication of the embryo becomes reestablished or whether in obedience to the law of growth the sciatic becomes sufficiently elongated and enlarged to substitute successfully the function of the femoral for blood transportation?

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PRELIMINARY LIGATION OF COMMON ILIAC ARTERY IN HIP-JOINT EXARTICULATION*

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ONE cannot seriously contemplate exarticulation of the hip without developing an acute interest in the experience of those who have preceded him. When it is to be combined with a preliminary ligation of the common iliac one's interest is naturally increased. There have been too few of the double operations successfully completed to have clearly paved the way for its routine application, and that more light may be shed on the procedure a brief reference to the valiant and instructive efforts of these pioneers may lend interest to the study.

Hip Amputation.—Now and then, there appears in the medical firmament a man with an idea endowed with the persistence necessary to enforce its development and recognition. Such a man was Morand. In 1729, fifty years before the idea was put into actual practice, before the Royal Academy of Surgery of Paris, he represented amputation through the hip-joint as not only possible, but practical. As is usual, when departure from the beaten path of experience and empiricism is advised, the promoter is condemned as a radical and he is shamed into silence; but not so with Morand. After a decade of waiting, through the medium of two of his followers, a thesis was presented to the Academy, describing in detail the operative procedure and reiterating his belief in its justice and practicability. It was promptly and unanimously rejected. In 1756, he succeeded in having the subject discussed in a prize essay and twelve responded, all of which met the same fate at the hands of the men of science. Finally, three years later, with admirable faith in his convictions, he was again able to secure the presentation of the subject in a prize essay. Of thirty-four contestants, nineteen favored the procedure, and a defender of the operation, Barbett, was awarded the prize. Morand died before an amputation was attempted, yet one must assume that his satisfaction in the acknowledgment of the feasibility of his radical suggestion, brought well-deserved solace to his final days.

Kerr, of Southampton, records the first completed attempt at hip amputation, in 1774, and although he inadvisedly performed it on a tuberculous hip, the fact that the patient lived fifteen days clearly refuted the contention that immediate death would follow, and lent courage to those who had occasion to attempt it later. During the Napoleonic period, it was applied in military surgery and at least two survivals are recorded, at the hands of Lorrey, the Emperor's noted

* Read before the Southern Surgical Association, December, 1920.

surgeon. Since that time, with the gradual improvement in surgical technic, antisepsis and asepsis and a clearer knowledge of the indications for hip-joint amputation, many successes have resulted in both civil and military practice.

The unusually high mortality following removal of one-fifth the body weight, especially under the unfavorable circumstances that invariably attend the act, should justify this report. In so far as our information serves us, but few previous reports have been made of premeditated permanent transperitoneal ligation of the common iliac as a preliminary step to exarticulation at the hip-joint. A recent case was attended by Barney Brooks, of St. Louis, and will be referred to later. Halstead's admirable "Review and Report upon the Effect of Ligation of the Common Iliac Artery on the Circulation and Function of the Lower Extremities" furnishes convincing proof of the ability of the collateral circulation to continue the necessary blood supply to the limb. Thus is removed any uncertainty as to subsequent viability of the stump in hip disarticulation, provided the anastomotic circle is not broken by disease of the blood-vessels themselves. It is obvious that in so brief a discussion all reference to the etiology and pathology of the conditions necessitating this operation must be omitted.

In reviewing the opinions of various authors as to the actual cause of the high mortality, loss of blood stands paramount. One does not ignore the fact that in the majority of instances where the operation is indicated, the resistance of the patient has been broken and his vitality undermined by long-continued disease, or has been weakened by severe trauma, hemorrhage, or sepsis. It would, therefore, seem incumbent upon us in our search for an effective check to the high per cent. of fatalities to directly attack the causes that contribute so generously. In the order of their importance these factors are hemorrhage, shock, and sepsis. Shock is so closely related to hemorrhage that a concise definition is impossible. Its prevention, control, and relief are so dependent upon the pre-operative precautions, operative technic, and post-operative care, that further discussion here would seem ill advised. Sepsis, since a knowledge of its prevention has become general, has been the accepted cause of death in so small a number of cases that it may be dismissed as an unimportant factor. When death follows so formidable a procedure from shock, hemorrhage, or both combined, it occurs before serious infection has time to make itself known, even though it were present to an alarming degree.

There are but rare occasions when hip-joint disarticulation is so immediately imperative that primary blood loss and shock from the original trauma cannot be eliminated before operation. The blood picture may be improved and the stability of the patient reestablished until sufficiently fortified to withstand an ordinary amount of shock and hemorrhage, and the operation can proceed by any ordinary method with a fair assurance of success. Under such conditions any of the various forms of

tourniquet control that can be applied and held sufficiently high to give ready access to the hip-joint structure should be acceptable. Prevention of tourniquet displacement was cleverly accomplished by Wyeth with the aid of transfixion pins. His greatly improved method, familiar to all, will satisfy all ordinary demands and in the great majority of instances is the safest and most effective. Similar control of the tourniquet is obtained by Deaver and others with retraction bandages over the opposite shoulder or supported by an assistant. Senn exposed the femur by a lateral long-axis incision and by blunt dissection, posterior to the adductor group, insinuated a double elastic, thus constricted the two halves separately, leaving the femur free for removal. Each of these and other similar methods have the disadvantage of preventing free access to the pelvic girdle attachment of the muscles of the thigh that as a future source of danger it may be desirable to totally resect. In obese patients the deep vessels are sometimes controlled with difficulty and the general oozing seemingly insignificant may endanger the balance of power when the margin of safety is slender, and should not be considered negligible. Wyeth, after ligating the femoral, obturator, sciatic, external and internal circumflex, very properly remarks: "If every oozing point were ligated, from one-half hour to an hour would be consumed in securing a dry wound in the majority of cases." This oozing he controls by quilting the muscles of the stump. He reports sixty-nine cases operated by his method with a mortality of 15.9, a most flattering decrease from the day of Walter Brashaer, whose hip disarticulation in 1806 is the first on record in this country. As described by Prof. D. Y. Yandel in "American Practitioner and News, 1890," Brashear "made a circular incision, divided the muscles well below the hip-joint, securing the vessels as the operation progressed. A longitudinal incision along the outer side of the limb exposed the remainder of the bone, which being freed from its muscular attachments was disarticulated at the socket." This is evidence of how little our technic has improved in the last century, as well as a tribute to the intrepidity of the Kentuckian. In 1881 Prof. John Ashurst, Jr., wrote: "A removal of the lower limb at the coxofemoral articulation may be properly regarded as the gravest operation that the surgeon is ever called upon to perform, and it is only within a comparatively recent period that it has been accepted as a justifiable procedure. The most pressing risk is that of hemorrhage."

Circular No. 7, War Department, S. G. O., 1867, publishes a most impressive report on "Amputations at the Hip-joint in Military Surgery," presented by Lt. Col. Geo. A. Otis, at the request of Surgeon General Barnes. Fifty-three instances of hip-joint amputation are rehearsed in detail. He reviews in most interesting fashion the history of hip-joint exarticulation down to his period.

He cites 108 amputations for gunshot injuries up to the time of the Civil War, of which ten recovered, a mortality of 91.6 per cent.; 111 hip-joint amputations in civil practice with forty-six recoveries,

a mortality of 58.5 per cent. Otis ascribes the cause of death to "shock to the system, secondarily to hemorrhage, primary and secondary, and to sepsis." The external iliac was easily controlled in most instances, the greater danger coming from the branches of the internal iliac. Consequently aortic pressure of many types was tried from the illogical 24-inch intrarectal wooden compressor of Davey, to digital or fist compression of the femoral and aorta. Secondary hemorrhage was not uncommon, and persistent stump bleeding was the cause of death in several instances.

Preliminary Ligation of the Common Iliac.—The struggle to swing the formidable operation of hip-joint exarticulation toward the safety column has met only with the measure of success one might rightfully expect from improved asepsis and surgical finesse. The death-rate is still too high and the control of hemorrhage and consequent diminution of shock by means that most assuredly do not increase the danger, is a logical aspiration. In the opinion of the writer, preliminary ligation of the common iliac increases to a justifiable degree the element of safety in those cases wherein further loss of blood and augmented shock cannot be tolerated. Such complete control of stump hemorrhage is thus obtained that the application of six to ten hæmostats is sufficient to assure a dry field. The muscle planes can be gently approximated with negative tension without fear of oozing, or of threatening the viability of the stump. Considering the ease with which common iliac ligation is accomplished and the added safety promised, one cannot refrain from wondering why we have hesitated for so long to carry out in detail the principle which even though crudely has been attempted in practice for so many years by such worthy surgeons as Esmarch, Mott, Lister and other pioneers, with the aid of various abdominal tourniquets in an attempt to compress the abdominal vessels and thereby diminish the strength of the current to the affected area. Temporary direct pressure of the common iliac in the treatment of aneurism of the pelvis and upper limb has been practiced for many years with varying success. Some of the experiences are so interesting that it is regretted they cannot be recited in detail. Valentine Mott, in 1827, deliberately tied a common iliac artery in an endeavor to cure an iliofemoral aneurism and was successful in that the patient lived and recovered. Professor Halstead, of Johns Hopkins University, in assembling the recorded cases of ligation of the common iliac artery which have been reported since 1880, was a pioneer in attempting to prove that the operation is entirely feasible. He estimates an average of one ligation a year for the last one hundred years, the great majority of the efforts being directed toward the cure of aneurism. Stephen Smith reports all ligations between 1829 and 1859, including one of his own, and states that the indications which have led to the deligation of the primitive iliac artery may be divided as follows: (1) For the arrest of hemorrhage. (2) For the cure of aneurism. (3) For the cure

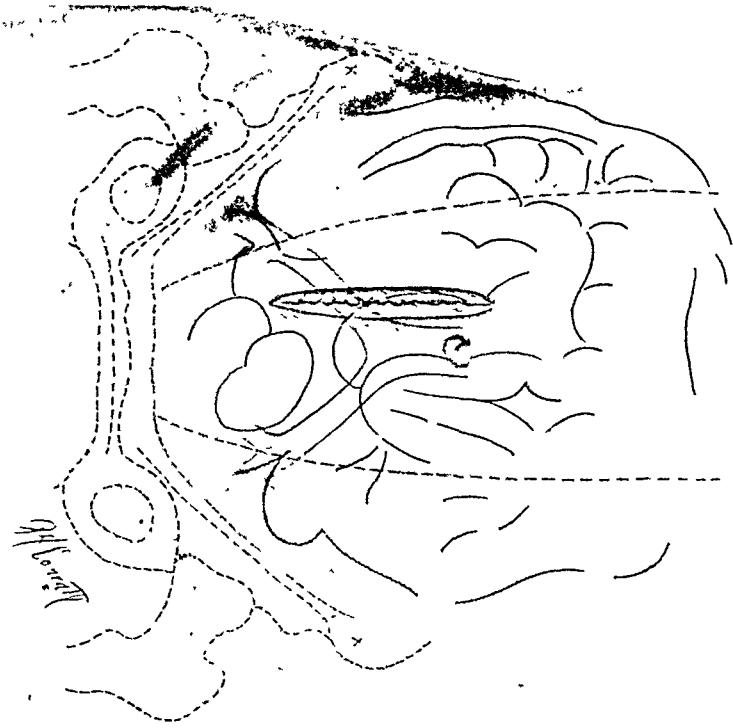


FIG. 2.—Location and relation of ligating incision.

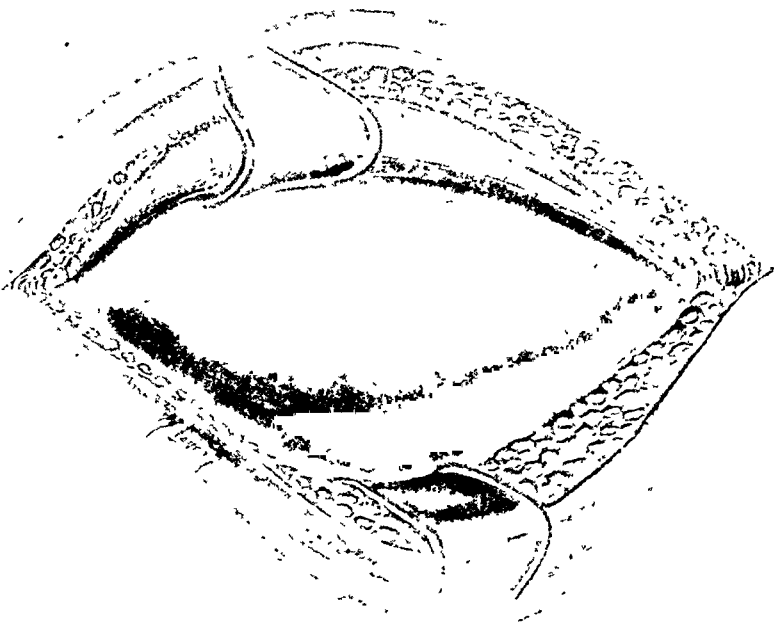


FIG. 3.—Bulging peritoneum between retracted rectus and median lines, a generous time-saving exposure.



FIG. 4.—Patient in head-down position, intestinal loops elevated, pre-iliac peritoneum divided, ureter pushed aside, and ligature-carrier in position.

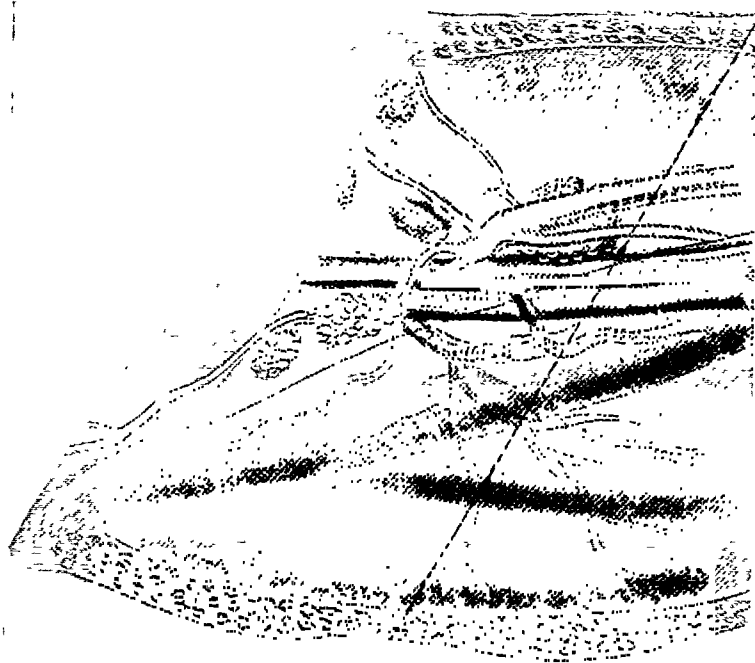


FIG. 5.—Relation of structures at line of skin incision. Inguinal glands and involved muscle groups to be reached through elevation of skin cuff.

FIG. 6.—Exposure and blocking of sciatic nerve. Alcohol injection between cocainized area and line of division.



FIG. 7.—Knife entering capsule at colyloid margin, from which point it follows bone surface to meet circular incision.

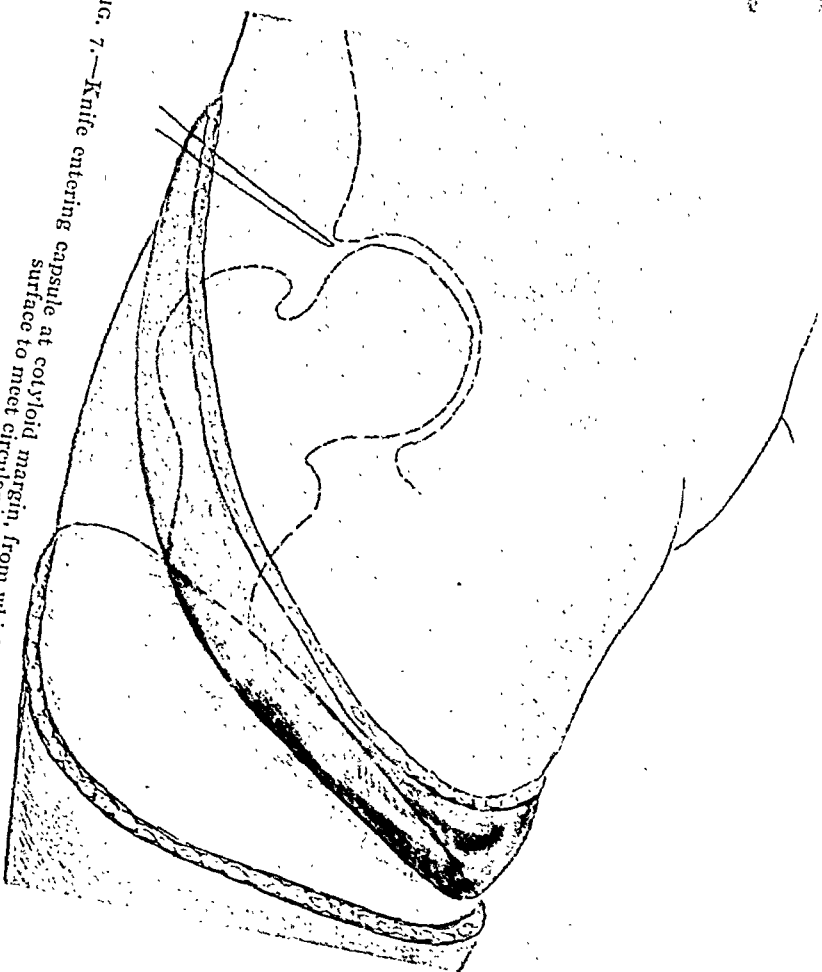




FIG. 8.—Knife has severed round ligament and remains behind delivered head of femur to divide capsular ligament and attached muscles of lesser trochanter and shaft.

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of pulsating tumors which prove to be malignant growths. (4) For the prevention of hemorrhage in the removal of marrow growths. And concludes even at that early date and in the face of an astounding mortality that "A proper appreciation of the circumstances under which the primitive iliac artery has been tied for the arrest of hemorrhage will need the discriminating surgeon, notwithstanding the excessive mortality that has

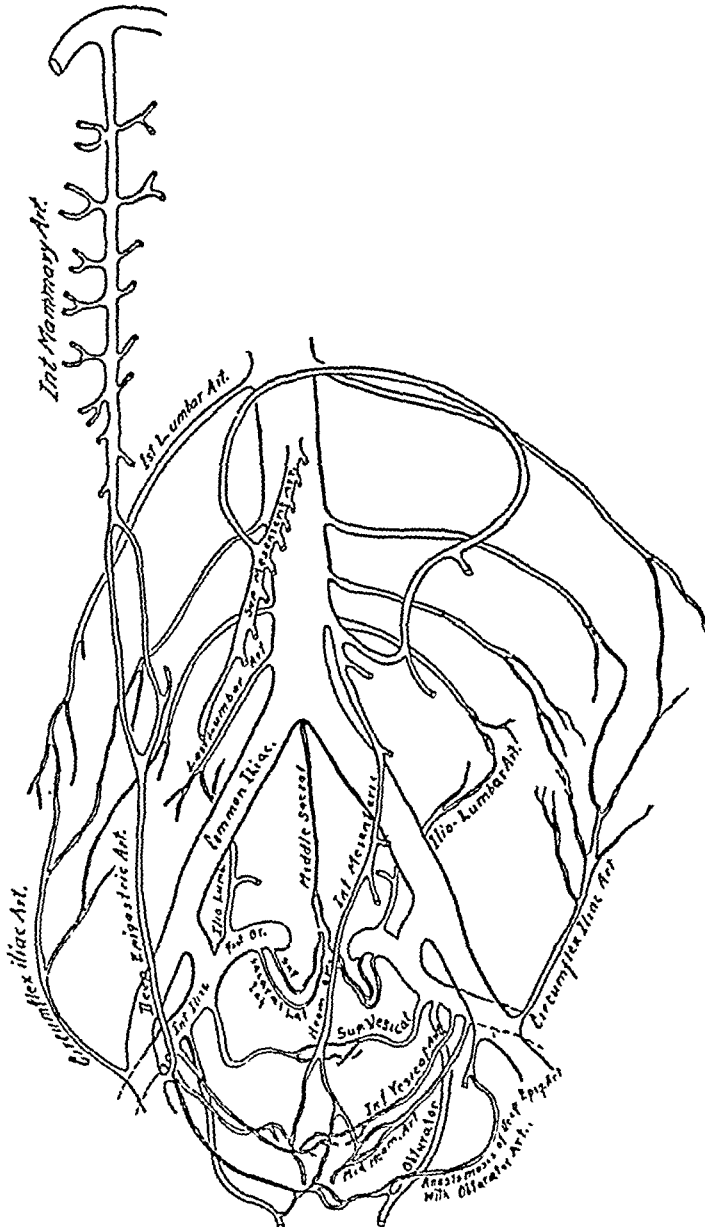


FIG. 1.—Showing collateral circulation.

thus far attended its performance, to accord to this operation an important place among the resources of his art." After many years of effort on the part of various surgeons to control bleeding about the hip girdle by the aid of pressure upon the intra-abdominal vessels, McBurney, assured of the safety of invasion of the peritoneal cavity, practiced direct pressure upon the common iliac through the incision that bears his name, in three cases of hip-joint disarticulation with complete success. Since

this time his method has been successfully applied by others. If it be true as stated by Halstead that gangrene of the extremity does not follow occlusion of the common iliac even without amputation, there can be no well-founded objection to permanent ligation of the vessel in preference to temporary compression, wherein control of the blood-stream must necessarily be somewhat indefinite.

The case reported by Brooks which was operated by him in July, 1920, as well as the one reported herein by the writer, were both extremely unfavorable risks. Both had been subjected to operative trauma and regeneration of malignant activity and presented physical conditions that made the procedures unusually unpromising. In both cases a preliminary ligation was done and both have recovered from the operation. It is true the number of cases which have received this preliminary step is so few that one has not the right to draw conclusions. It is not with the intention of assuming that unusual significance should be attached to any individual case that the author urges the application of this preliminary step in selected cases, but for the reason that the principles involved therein are supported by the accumulating experience of all the cases recorded, tending to prove: (1) That ligation of the common iliac is perfectly safe from the standpoint of continued viability of the stump; and (2) that hemorrhage is absolutely under control, time is saved and shock is materially diminished.

The report of the author's case is briefly as follows:

Master J. Kendis, aged thirteen years, entered St. John's Hospital in August, 1920, with a history of indefinite pain and swelling in the right knee, following an attack of tonsillitis. Tonsillectomy was performed and symptoms in the right knee disappeared for a few days. Swelling with terrific pain soon returned. Laboratory test taken at that time reported a three plus Wassermann. Anti-luetic treatment was carried out for several weeks, even though repeated reexaminations begun immediately after the positive report have all been negative. X-ray report at the time showed a large area of bone destruction in the epiphysis of the right femur at the knee, extending onto the diaphysis at its lower end and mainly confined to the mesial side. No definite proliferation could be made out. Cortex of bone intact. Contiguous surface of the tibia not involved. There was slight increase in the synovial fluid of the knee-joint. The röntgenologist reported it a tumor strongly suggestive of giant-cell sarcoma. On October 28, 1920, a specimen of tissue containing bone was removed from the leg by Dr. A. Horwitz, who referred the case, and a pathological report was returned as follows: "Round-cell sarcoma with perithelial arrangement."—Dr. E. L. Opie. November 2, 1920, Dr. W. Temple, of Kansas City, reported from the same section, "Endotheliomata tumor belonging to sarcoma group." Dr. Ralph Thompson, pathologist of St. Louis University, on November 29, 1920, reported

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the specimen as osteosarcoma. The reaction incident to removal of tissue by Doctor Horwitz was unusually severe. As indicated by the graphic chart, the pulse-rate varied from 140 to 160, with a rise of temperature, ranging from 102° to 104°, and unbearable pain in the joint area. Smears from the wound secretion contained mixed bacteria, staphylococci and streptococci. It was determined to reestablish, in so far as was possible, the resistance of the patient before subjecting him to disarticulation at the hip. The wound was accordingly Dakinized for several days, with slight improvement in temperature, but no decrease in pulse-rate; consequently it was determined to proceed with the operation in the hope that removal of the pathology would be sufficiently beneficial to overbalance the danger of the operation, especially in view of the fact that his general condition was not improving and that metastasis was probably active. With the encouraging example of the successful case reported by Brooks, it was determined to ligate the common iliac as a preliminary step. Under ether anæsthesia the operation was performed, with the following technic:

Patient is placed in Trendelenburg position immediately following preparation of field of both operations. Incision (for ligation of common iliac) commences one inch above the umbilicus and near the mesial margin of the rectus muscle, which when exposed is retracted outward. A broad peritoneal exposure is thus obtained. Upon admitting air to the peritoneal cavity, the intestines fall back and but a light, moist, gauze compress is needed to maintain excellent exposure of the aortic bifurcation and both common iliacs. The peritoneum over the site selected is elevated, snipped and stretched, the artery by blunt dissection is isolated from the vein and elevated, the loaded ligature carrier directed toward the patient's left is passed under the artery, and the iliac doubly tied and interlocked by heavy braided silk. One hour-glass suture suffices to repair the peritoneal rent. The table is brought to a level and the abdomen closed in the usual manner. The entire procedure can be accomplished in a few minutes. Elevation of the affected limb is meanwhile maintained. For the completion of this report the exarticulation is briefly described: A circular incision at the selected height is made about the limb through skin and fascia, observing a line parallel to the line from pubic spine to iliac crest, that the anal side of the flap may be longer than the lateral. Selecting a point midway between the head of the greater trochanter and the crest of the ilium, a three-inch knife is thrust home to the head of the femur, entering the capsular ligament at the cotyloid margin. Continuing the pressure, the knife is carried down through all tissues to the femur on its lateral surface to join the circular incision below. The limb is elevated, the skin cuffed and the sciatic nerve exposed in its intermuscular bed at a height several inches above the proposed line of muscle section. The nerve is blocked with 1 per cent. novocaine, and 2 c.c. of alcohol, as suggested by Dean Lewis, is injected immediately distal to the novocaine infiltration and the

nerve divided. Acutely adducting the limb, the round ligament is severed and as the head emerges from the longitudinal incision in the capsular ligament the knife remains behind and divides in one stroke the remaining joint ligaments. The muscle groups attached to the greater and lesser trochanters and the shaft may now be divided by a few strokes of the knife, the circular muscular incision at the base of the skin cuff completed and the limb removed. The femoral vessels are compressed by the free hand of the operator during this last circular stroke and immediately occluded with hæmostats, as are the gluteal, sciatic, obturator, internal and external circumflex and two or three less significant branches, requiring in all not over eight ligatures to block the termini of the collateral arch. Because of the interest attached to the rapidity with which the collateral circulation asserts itself following deligation of the common iliac, the femoral was momentarily relieved after incising it and a fairly full stream of blood about the strength of the venous current greeted us. The bleeding from the less important vessels, such as the gluteal, sciatic and obturator was of less force, rising to a height of one to two inches, as they were relieved from the compress, for location and ligature. It is interesting to note that no pulsation was observed in any of the vessels that were permitted to bleed momentarily and that the stump, after the few ligatures were applied, remained perfectly dry. Mattressing the stump end was done for cosmetic effect and not for the insecure purpose of controlling oozing. A Dakin tube was directed into the acetabulum and one at the stump end, thus excluding infection and temporarily caring for dead space and serum accumulation. The after-care of the case presents no feature of interest, not depicted on the graphic chart. A donor was present, and kept available for use should occasion arise. Post-operative shock was never sufficiently alarming that hypodermic or intravenous medication was deemed necessary. The pulse-rate continued high as before operation, and while gradually slowing, remained above 100, and following each X-ray therapy was markedly exacerbated for a time.

As previously stated, conclusions based upon the slender support of a few successful cases would be valueless. Modern surgery has happily reached the stage when conservation is the aim and amputation the exception. Year by year the need for disarticulation at the hip-joint will diminish, but when demanded, will assuredly be less hazardous. The patriarchs of medicine who have had to blaze the trail, upon which we walk with comparative comfort and assurance, are deserving of unstinted praise. We are inclined to forget in our selfish enthusiasm the great work that our predecessors have accomplished, that has made our small contributions possible and upon which they are founded. The creation of such an impression is far from the desire of the writer. Attention is directed, in conclusion, but to a few points of interest in this report: Exarticulation at the hip-joint is a hazardous procedure, because of two factors. First:

the injury or disease making the step necessary has already seriously handicapped the patient. Secondly, hemorrhage, shock, and sepsis in the presence of lowered vitality invite disaster. The logical solution, therefore, is: (*a*) To refrain, unless forced by emergency, from further trauma until recuperation compatible with safety is complete; (*b*) replenish by blood transfusion the depleted circulation, and reestablish as far as possible the physiological activity of the sufferer; (*c*) in elective cases control hemorrhage and therefore save time and shock by the five-minute procedure of preliminary ligation of the common iliac, and finally treat operative shock *before* it develops by preventing all blood loss, nerve and tissue trauma, and prolonged anæsthesia. It is in the belief that the steps suggested herein are directed toward safety, and are unfriendly to high mortality, that the case is reported.

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CANCER INFECTION*

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AS FAR back as medical history extends there have been certain diseases which have been looked upon and feared by the public because they have been supposed to be transmissible from one person to others in some way. Their mode of transmission has been explained in many cases since their etiology has been determined by finding certain microorganisms which could be isolated, grown upon culture media, and which when inoculated upon healthy animals or upon human beings produced the identical disease from which the patient suffered from whom the original microorganisms were taken. In this manner diseases which had for centuries been looked upon as contagious or infectious were definitely proved to be so. Other diseases, like measles, scarlatina, and smallpox, in which it has not been possible to isolate the specific microorganisms, are so evidently due to infection that no one is in doubt about this fact.

For many years the public consciousness—often called superstition—has recognized the infectiousness of tuberculosis, leprosy and cancer, while many of the most learned members of the medical profession have claimed the contrary because the infectious character has not been demonstrated on account of technical difficulties. These have fortunately been cleared away in the case of tuberculosis and leprosy, but not as yet, so far as general knowledge is concerned, in the case of cancer.

Had Robert Koch or some other investigator not demonstrated the tubercle bacillus, there is no doubt but what hundreds of thousands of healthy persons who are now protected against tuberculous infection would still be exposed to this danger precisely as they are exposed to the danger of infection from cancer to-day. This is due to a simple error in logic. We disregard the popular prejudice because we cannot demonstrate a scientific basis for this prejudice instead of accepting the popular prejudice as being in all probability based upon observation and knowledge which were lost during the dark ages, but which were well founded upon fact during the ages which preceded this period of ignorance. We say because we cannot find the agent of infection therefor it does not exist, instead of saying our ignorance and incompetence and lack of skill and insight have prevented us up to the present time from discovering this agent, hence we must approach the question always from a new

* Read before the Southern Surgical Association, December, 1920.

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angle until we will ultimately succeed in establishing conditions which will enable us to determine this cause.

We may say that the appearance of cancer is preceded so constantly by long-continued local irritation, as in smoker's cancer, the cancer of betel-nut chewers, that of paraffin workers, chimney-sweeps, etc., that we are justified in considering this irritation as the actual cause. What would we think of a farmer who would fail to put seed on his land because he has observed that the soil has to have a certain degree of preparation before a certain crop can grow? In the same way we have observed that cancer will develop very constantly on the proximal side of the pylorus and on the distal side of the ileocecal valve, while it will develop only rarely between these two points. The fields in which it will develop contain substances acid in reaction, while the intestinal contents in the intervening portion are alkaline. The farmer knows that he can grow rye in an acid soil but in order to produce a growth of alfalfa or red clover the soil must be alkaline. In either case, however, he must sow the specific seed which will produce the growth desired.

We know that it is an easy matter to transplant carcinoma nodules from one animal to another but that if these nodules are exposed to a temperature of 160° F. no growth will occur. This may mean that the tissue itself cannot live in a temperature higher than this or it may mean that this is the limit for the life of the infectious material causing the cancer.

For many years the fact that the few experiments in transplanting human cancer from one person to another have failed has been looked upon as proof for the non-transmissibility of cancer from person to person. Of course, this has been long disproved by animal experimentation, but it serves as an example of the harm that can be done by concluding that because one has failed to prove a fact therefore it has been disproved or because one has not been able to do it therefore it cannot be done. For years the failure of attempts to transplant cancer or to inoculate cancer from one person to another was used as an argument against the infectiousness of cancer. This would not be of much importance were it not for the fact that in the meantime, while we are waiting for some person who is competent to discover the cause of infection, the public are encouraged in exposing themselves to this infection, against which popular prejudice might otherwise protect these persons.

A study of the literature shows that less than thirty years ago Langstaff ("Studies in Statistics," London, 1891) and many others proved statistically and to their minds scientifically that tuberculosis is not infectious or contagious because in many families the husband or wife suffered and in many instances died from the disease, the other partner remaining free from it. This identical argument is being advanced in the case of cancer. The fact that the soil must be proper as well as the seed

in order to secure growth is being overlooked in the case of the cancer as it has in every disease which has been classed as infectious or contagious by popular belief or prejudice.

The experiment of Miss Slye with white mice shows conclusively that certain animals are more susceptible to the development of cancer of heredity than others.

TABLE I

<i>India</i>		<i>Japan</i>	
Per cent. of Carcinoma deaths		Rate per 100,000 population	
	0.0 Stomach	52.3	_____
	0.0 Esophagus	12.4	_____
_____	6.0 Liver	7.3	_____
_____	8.0 Buccal	2.3	_____
_____	1.4 Larynx	2.3	_____
_____	13.2 Skin	0.8	_____
_____	13.0 Breast	0.6	_____
_____	6.0 Uterus	11.0	_____
_____	18.0 Male genitalia	0.7	_____

TABLE I.—Shows the difference in distribution of cancer to different parts of the body in nationalities whose habits of living are very different, the parts of the body exposed to contact with filth being extensively infected with cancer.

TABLE II
Total Cancer Mortality per 100,000

Copenhagen	161.3	_____
Berlin	133.5	_____
Amsterdam	116.7	_____
London	111.7	_____
Rome	100.5	_____
Moscow	94.8	_____
Sydney	90.1	_____
Petrograd	85.6	_____
Buenos Ayres	85.1	_____
Chicago	78.9	_____
New York	77.1	_____
Tokio	73.6	_____
Osaka	55.9	_____
Calcutta	11.7	_____

TABLE II.—Shows the number of deaths from cancer per 100,000 of population in different important cities.

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TABLE III
Hawaii, 1911-1913. Rate per 100,000 by race and organ.

Total	Breast	Face	Int.	Stomach	Uterus
Japanese 19.8	0.0	0.0	12.1	57.6	18.2
Chinese 26.5	0.0	8.3	0.0	50.0	16.7
Portuguese 58.0	3.7	0.0	0.0	40.8	7.4
Hawaiian 93.8	13.7	0.0	2.0	27.5	29.4

Asia

Ceylon 5.6	
Hongkong 8.1	
India 11.7	
Penang 10.3	
Japan 60.2	
Shanghai 55.3	

TABLE III.—Shows death rate per 100,000 by race and organ.

TABLE IV

Stomach and Liver	Int.-Rectum Peritoneum	Breast	Skin	Buccal cavity
Switzerland			|	|
Holland			|	|
Japan		|	|	|
Scotland			not given	
Uruguay			|	|
England and Wales }			|	
U. S. A.			|	|
Australia			|	

TABLE IV.—Shows the relative frequency of cancer in different organs for various countries.

These tables were constructed from statistics taken from the volume published by Frederick L. Hoffman, statistician of the Prudential Life Insurance Company, who has given the subject an enormous amount of attention.

The fact that whole families of human beings have died of cancer has been used as an argument in favor of infection because living together they are all likely to be exposed to the same sources of infection. The same has been claimed for houses in which successive families have died of cancer.

On the other hand, these conditions have been ascribed to coincidence or to hereditary tendency.

The fact that surgeons do not generally die of cancer has been given as an argument against infection. If one observes the care with which surgeons guard against possible infection of any kind this argument at once loses all weight.

The fact that we find the same histologic structure of metastatic cancer that we find in the primary growth has been used to discredit the infectious theory. Metastases must consequently be transplanted particles of tumor tissue and not infections at a distance from the original growth. If the cause of cancer is an infection apparently it sets free living cells, some of which will continue to grow after being carried to a distance by the lymph-stream or the blood-stream.

There seems to be an exception in case of Paget's disease of the breast, in which one may find squamous epithelium in the original cancer about the nipple, columnar epithelium in the secondary cancer along the milk duct and glandular cancer in the mammary gland, while there may be metastases in the axillary lymph-nodes with characteristic glandular cancer. In these cases apparently the skin, the milk ducts, and the gland tissues were successively infected, while the new growth in the lymph-nodes represents a true metastasis.

In urging the importance of taking every precaution against cancer infection, notwithstanding the fact that its infectiousness has not been proved, we simply suggest a wise precaution which can do no harm, while it may do an endless amount of good, because in case the disease is due to infection every additional case is a menace to others.

In the meantime it would be equally unwise to ignore the various other theories which have been advanced. According to Virchow's theory, cancer is due to local irritation either mechanical, as in the form of friction or pressure, as in smoker's cancer and the cancer of betel-nut chewers, or chemical, as in paraffin workers, chimney-sweeps, and electric irritation, as in X-ray workers, or heat, as in workers in certain trades.

This theory has an important practical bearing because by avoiding all of these forms of irritation undoubtedly many cases of cancer can be avoided, according to the view of those believing in cancer infection because the soil has not been prepared for the infection.

Cohnheim's theory of embryonic origin, Hanseman's of "anaplasia," Ribbert's of "tissue tension," and Adami's of "habit growth," all aid in explaining the development of cancer, but in each instance the seed in the form of some form of infection is missing.

The fact that cancer is a disease of old age can be reasonably explained from the fact of: (1) Reduced resistance; (2) long years of exposure to irritation; (3) long time of exposure to cancer infection.

The fact that cancer occurs upon the exposed portions of the body and not upon the parts covered with clothing would point toward the

fact that the exposed portions are not only more exposed to external irritation but also to infection.

In the case of the Kangri burns of Kashmir which cause cancer of the abdominal skin underneath the charcoal warmers worn over the abdomen, we have the constant irritation coupled with the fact that these people are extremely uncleanly, so that no part of their bodies is free from infectious material.

Cancer occurs almost exclusively in portions of the body exposed to the irritation of the outside world. This includes the gastro-intestinal canal which comes in contact constantly with filthy food in locations in which stasis insures long-continued contact and persistent irritation.

We find a notable example in the enormous amount of cancer of the stomach in manure-eating people, *i.e.*, people eating raw vegetables growing in soil fertilized with night-soil or with barnyard manure. A marked example of this is found in the Japanese, who eat such vegetables in abundance and who suffer greatly from cancer of the stomach, while the inhabitants of India, whose religion commands them to boil food and drink, are notably free from stomach cancer.

On the other hand, the Japanese are scrupulously clean regarding their skin, being habitual bathers in hot water. They are very free from external cancer. The people of India, on the other hand, who are not clean as regards their skin, suffer largely from cancer of the skin. The same is borne out among the manure-eating animals. Barnyard fowl are notoriously unclean in their diet and those individuals who do not lose their lives while young are very prone to suffer from cancer. The same is true of the pig, although according to our modern methods, these animals are marketed so young that they rarely reach the cancer age. Is it not possible that the founders of the Jewish law prohibiting the eating of pork may have been founded on knowledge? The same is true of dogs, rats, and mice, who are all subject to cancer, while animals like rabbits and others eating clean food are practically free from cancer.

Marine and Gaylord have shown that fish living in ponds infected with excrement develop cancer, especially of the gills, which are the least protected part of the body constantly in contact with the soiled water, while control animals living in pure water will remain free from this disease.

There are many facts which seem to point to sewage and manure as the home of the organism causing cancer. Behla made a careful study of Luckau and found that cancer was four times as common in the low-lying portions as in the higher regions; in other words, in the portions to which the drainage was carried. He also found much cancer in dogs in this region. He also found that the communities afflicted severely with cancer consumed large quantities of home-grown vegetables. In this part of the country human excrement is used extensively for fertilizing vegetable gardens. Haviland also found after careful analysis that low-lying districts are full of cancer. Mason, in his careful investigation of 400 cases at Leamington, England, came to the conclusion that sewage is

an important factor in the production of cancer. An apparent discrepancy comes from the statistics of the city of Edinborough, showing that cancer was found to be more frequent in houses demanding a high rental while tuberculosis was more frequent in houses of low rents. However, it seems clear that the former occupants could afford to eat raw vegetables while the latter had to be satisfied with porridge and less expensive foods.

Again Meldorf states that of 1500 patients in Esquimeaux only 1 per cent. had tumors and that only a few of these were malignant. The low percentage of cancer in the arctic regions has been confirmed by many other observers. In these regions no vegetables are grown which are fertilized with human excrement or with manure, hence there can be no contamination with human excrement. An important exception to this is the city of Hammerfest, but I have not the data concerning its food supply nor its water and sewage systems.

In the tropics observers agree that cancer of the stomach is extremely rare. Here again this form of contamination is absent except where the vegetable gardens are conducted by the Chinese or Japanese. In the tropics human excrement is not used in fertilizing garden vegetables because these grow vigorously without this aid; moreover, fruits are so plentiful that they are used in preference and, of course, these are not easily contaminated.

In studying the statistics I have been impressed with the fact that cancer of the alimentary canal is uncommon wherever food and drinking water are not contaminated with sewage or manure. An interesting observation has been made in the case of the Chinese who drink no unboiled contaminated water but eat an abundance of vegetables fertilized with human excrement. As might be expected, they show a high mortality from stomach cancer.

The most convincing argument, however, of the infectiousness of cancer lies in the studies of Professor Smith, who has proved to the satisfaction of those competent to judge that cancer in plants is due to a microörganism which he has been able to isolate and cultivate and which produces cancer when inoculated upon healthy plants. In human cancer further studies are needed, and it is hoped that these will be continued vigorously and that in the meantime healthy persons be not exposed unnecessarily to cancer infection.

The fact that none of the many observers like Roppin, Schill, Francke, Lampiasi, Scheuerlen, Konbassoff, Doyen, Wickham, Thoma, Sjobring and many others have been able to prove to the satisfaction of others that they had found the microörganism causing cancer must not be construed to prove that such an organism does not exist, because precisely the same failures were experienced before the tubercle bacillus, the bacillus of leprosy, the spirochæte of syphilis, the plasmodium of malaria, and many others were finally discovered.

Clinically all of these diseases were infectious and it was only a matter of patient labor to find the living cause.

CARCINOMA OF THE KIDNEY*

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Prior to 1883 no attempts to classify renal tumors appear to have been undertaken, practically all being described either as lipomata, cancerous or cystic. Grawitz, however, at that time definitely identified a certain predominating group as originating from adrenal rests. These are now known as hypernephromata. His observations were contended chiefly by Stoerk and Sudeck, who claimed that they were of renal origin, while Wilson in a recent exhaustive embryological study believes that these tumors arise from islands of nephrogenic tissue and suggests the term of mesothelioma to designate them.

Etiology.—In 1884 Labourin, in examining tumors of adenomatous character, stated that he believed they arose as a process of epithelial transition in certain instances of chronic nephritis. The observations of Taddei and Kitchenski tend to a more plausible explanation, which may be supported by many analogous facts found elsewhere in the body; namely, that carcinoma of the pelvis of the kidneys is quite probably due to a metaplasia of its transitional epithelium, and that it is the stimulation of these plaques of leucoplakia either by a preëxisting stone, infection, or by chemical reaction of retained secretion that causes the resultant growth. The observations of Israel, Kielleuthner, Oraison, Rokitansky, Weichselbaum, Kauffmann, Halle, Orth, Bauer, Albarran and many others would lend credence to this theory.

The relationship of the presence of stone to cancer of the kidney is interesting in that statistically the percentage of their occurrence coincides very closely with the formation of cancer in other parts of the body where definite irritation is demonstrable, thus, as pointed out by Coryell in a study of fourteen cases of cancer of the kidney operated at the Mayo Clinic, nine, or 64 per cent., were associated with stones and five, or 35 per cent., occurred without stones, thus allowing an interesting analogy to be drawn between the relative frequency of gastric cancer developing on a gastric ulcer, and that of cancer of the kidney and the concomitant finding of stones.

In Coryell's study of local pathologic processes found in these stone cases, substantiation of the probability of the existence of a pre-cancerous stage is noted in the fact that one of the primary results of the presence of calculi is the proliferation of fibroblasts beneath the tubular epithelium. He believes that this newly formed tissue disturbs the normal equilibrium existing between the epithelium and the connective tissue,

* Read before the Society of Alumni of Bellevue Hospital, January 5, 1921.

which results in an epithelial proliferation. Thus it would appear evident that over-production of epithelial tissue in these conditions is due to a chronic irritation, and that the connective tissue becomes less resistant against the epithelial cells, as stated by Thiersch, while Ewing carries the process still further in stating that although the "epithelial growth follows the analogy of normal gland formation, owing to the process of adaptation to abnormal environment and loss of function, the atypical structure of cancer results." This attempt of cells in cancer of the kidney to mimic the formation of renal tubules has also been noted in the personal cases observed. It is most difficult to appreciate just where the inflammatory hyperplasia stops and the cancerous cells begin, and, as Ewing states, there appears to be an insensible gradation from one to the other. The process is stated schematically by Coryell as (1) normal; (2) inflammatory; (3) hyperplastic; (4) neoplastic (either benign or malignant).

There appears in all cases examined some type of inflammatory reaction. This may be due either to stone or infection, and in a very great majority of cases one notes that there has been either an intermittent or a continuous obstruction at the ureteral introitus. It is usually for this that the patient seeks advice. Ochsner feels that this stasis is the real factor stimulating the previously irritated tissues to cancer formation due to the continued presence of the acid medium.

Two types of carcinoma are to be noted, an infiltrating growth usually springing from the renal pelvis, and an adenomatous type invariably originating from the renal tubules. The papillomata found occasionally in the pelvis take on the characteristics of those seen in the bladder and while possibly benign in the beginning, unquestionably become the malignant papillary carcinoma when seen in the later stages, as so frequently occurs in similar vesical growths.

The average occurrence of carcinoma of the kidney when taken in relation to other tumors of this organ is about 7 per cent. The majority occurred before the age of fifty, while hypernephroma is more frequent after fifty. Males appear to be more susceptible to the development of carcinoma of the kidney, the ratio being about six males to four females. It occurs equally on both sides, and malformation or malposition does not appear to influence its occurrence, although it has been found in two instances of horseshoe kidney (Wolff, Primrose) as well as in an ectopic organ (Young), and although due to the rarity of these conditions these instances are striking, one can hardly ascribe much etiologic significance to the coincidence. The relationship of trauma apparently need not be considered nor does heredity influence the occurrence of kidney growths any differently from cancer found in other parts of the body.

Diagnosis.—There is no symptom-complex or pathognomonic sign whereby one may differentiate between the different pathologic processes present in solid tumors of the kidney, nor would anything be gained in so doing other than academic interest. The treatment is the same for

all—radical surgery. However, it is of the utmost importance that these conditions be recognized at the earliest possible moment, and according to the situation of the tumor this may be relatively simple or extremely difficult, taxing the ingenuity of the diagnostician to its utmost.

Three primary facts are to be considered, as it is invariably one or more combinations of these that first impels the patient to seek the physician. In their relative frequency of occurrence they are: (1) hæmaturia; (2) pain; and (3) tumor.

Hæmaturia.—Hæmaturia occurs in approximately 60 per cent. of cases of tumor of the kidney and holds good both for carcinoma and for hypernephroma. It may occur as a symptomless hæmaturia and exist either continuously or, what is more commonly the case, intermittently for months or even years. In Braasch's series of eighty-three cases it existed for more than one year in 77 per cent. Hæmaturia does not necessarily indicate involvement of the pelvis, although this is usually the case, but may come from the parenchyma, in some instances at least, due to congestion. The character of the hemorrhage is in many cases quite profuse but transient and not of much severity in the earlier stages. Its presence is of the greatest aid, however, when occurring at the time of examination, as its origin can then be definitely localized. The presence of microscopic blood is of questionable value, as the errors in technic in obtaining it through ureteral catheters are so many and so easily and unintentionally committed, and other more definite findings so simply obtainable that but very little weight should be attached to this finding other than corroborative, and when found in passed urine it has no value whatever; indeed, in fifty cases of abdominal tumor simulating renal tumor examined by Braasch, but which on operation were found not to involve the kidney, 6 or 12 per cent. showed microscopic blood in the urine.

The appearance of frank blood in the urine in the large majority of cases of cancer of the kidney is usually symptomless, occurring without pain unless there is distal obstruction, when more or less ureteral colic is stimulated as the clot is passed.

It is a fallacy to believe, as is frequently stated, that pyuria is seldom present in renal growths, as in records of 126 cases pus was found in 39 per cent. of them, and we believe even this number smaller than it should be, as inflammatory infiltration is present in practically all of the stone cases at least.

Fibrinuria is an extremely rare condition which has been noted in two cases of tumor of the kidney—one a sarcoma, the other a carcinoma. As there are but twenty-six cases of this urinary phenomenon on record, it might be of interest to keep it in mind.

The writer saw last fall a most extraordinary instance of fibrinuria in an elderly woman, whose blood-pressure frequently ranged

between 270 and 300. She was extremely stout, so that abdominal palpation was impossible. The cystoscopic examination was negative, as was also radiographic examination of her kidneys. She would unfortunately not subject herself to pyelography and died after a few months apparently from nephritis and myocarditis. She not only voided, without discomfort, great masses of pinkish-white, transparent, gelatinous material, but at intervals the urine would be voided clear and the presence of fibrinogen convincingly demonstrated by the subsequently forming coagulum.

Pain.—The character of the pain complained of is not at all diagnostic of tumor of the kidney, as it varies not only in character, but also in its intensity and duration, in each instance being dependent upon its etiologic factor. Thus, one may have the colic of engagement of a stone or that accompanying the passage of a blood-clot; again the distention of the tumor causing pressure and local congestion gives the dull ache frequently complained of. Similar sensations occur from the frequency of concomitant hydro- or pyonephrosis. Peripheral pressure may cause neuralgic radiations to most any part of the abdomen; lumbago or muscular rheumatism are terms most commonly used to describe it. That it is an important element to consider in early diagnosis is evidenced by the frequency of it being the initial symptom complained of. Braasch states that he found it the primary complaint in 32 per cent. and present at some time during the course of the disease in 82 per cent. of the eighty-three cases considered. Acute, sudden or bursting pain may be interpreted as being due to a hemorrhage into the tumor or under its capsule or into the occluded pelvis, particularly if there is a sudden increase in the size of the tumor.

Tumor.—The presence of a mass as the first evidence of a renal growth, taking the collected statistics of Albarrn, Imbert and Braasch as a criterion (386 cases), shows it to have been noted in about 19 per cent., while after examination 82.4 per cent. of tumors have been identified in a series of 562 cases (including those of Garceau). Its shape and degree of fixation are extremely variable, both dependent on the nature, situation and character of the growth, and on the degree which metastases have fixed it to adjacent structures.

In the majority of the cases personally examined, it had tended to conform to the shape of the kidney itself and is difficult at times to differentiate from it, as a large white kidney simulates very closely the earlier stages of tumor formation before the process has invaded the sub-capsular tissues. They are frequently irregular and bosses may at times be readily appreciable. In general it may be stated that owing to frequently abnormally placed kidneys and to the presence of adjacent organs, the seat also of growths, it is quite inadvisable to base a diagnosis of renal tumor on palpation alone unsupported by other and even more indicative findings.

Diagnosis.—Probably the one single demonstrable fact that we have at our disposal upon which one may base the most accurate diagnosis of renal tumor, is the pyelogram. Frequent instances have been encountered, however, where this has been impossible owing to the impermeability of the ureter, either from stricture or from involvement of the tumor growth itself. The technic of its accomplishment is rendered safe and symptomless by allowing a 25 per cent. solution of sodium bromide to distend the pelvis of the kidney by gravity—the deformity noted may be of varying type, the most usual is the so-called “spider leg” appearance due to the retraction of the calyces into the cortex. The second most frequently found deformity is the splitting up of the pelvic shadow into irregular and disconnected streaks, probably due to incomplete occlusion of the normal cavity by invasion of it by the irregular tumor masses; much may also be inferred from lateral or mesial deviation or displacement of the shadow of the pelvis from pressure upon it or dislocation of it by the tumor. The ureter may itself show deformity in 70 or 80 per cent. of the cases owing to either tumor infiltration or external pressure upon it by a surrounding growth. One must be careful not to be misled by the finding of a stone shadow to believe that this is the only pathologic process present. Valuable data may further be obtained by general radiography of the kidneys, particularly by employing the pneumoperitoneum technic of Fischer, as not infrequently we may obtain shadows of the tumor mass, especially if a hemorrhage has occurred into it, or in thin people with dense tumor structure.

Renal functional tests are of doubtful value and should be interpreted with caution—no dysfunction is apparent in the large majority of cases unless there is a marked inflammatory reaction, when it is quite definitely decreased. We employ the phenolsulphonephthalein test exclusively, as not only retardation of elimination time but also quantitative estimations may be observed.

Accessory aids in the diagnosis may be found in various circulatory phenomena. Thus Guyon, in 1881, called attention to the presence of varicocele. This is particularly suspicious when occurring suddenly late in life or with the onset of kidney symptoms; it is coincident in between 25 to 30 per cent. of the males examined. Braasch observed the recent appearance of hemorrhoids in 16 per cent. of the last thirty cases examined.

Cystoscopy frequently demonstrates dilatation of the trigonal and adjacent veins or an atresia of the ureteral opening on the affected side, while blood-clots or discolored urine may be seen issuing from the ureter, or changed characteristics of the ejected urine, either in force or frequency, are occasionally noted.

The prognosis is very serious even in the most favorable cases, not only because of the usually advanced condition of the growth before it comes to operation, but there is a tremendous operative mortality—between 30 and 50 per cent. Owing to the lack of facility with which these large

tumors can be dealt with, through approach by the usual lumbar route, we do not hesitate to extend the incision transversely as far as the rectus muscle if necessary, and even further enlarge the approach by extension upward or downward. When one is able to infer that a papillomatous growth of the pelvis of the kidney is the probable lesion, because of concomitant finding of vesical papillomata, a complete ureterectomy should also be done either at the primary operation or secondarily, as recurrence in the ureter has been noted in six instances. The immediate shock from separating densely adherent tumors from surrounding structures and the resultant hemorrhage are factors which one has to contend with in many cases. A section of the inferior vena cava has even been removed accidentally; the operator was, however, successful in repairing it. The duodenum may readily be injured. Firm adhesions to the diaphragm may cause much inconvenience.

The subsequent history shows a very large percentage of recurrences—the approximate numbers of probable “cures” from considering many statistics is in the neighborhood of 25 per cent.

I append six histories of cases which have been shown pathologically to be carcinoma of the kidney. My thanks are due to Doctors Sherwood and Westbrook for permission to report their cases.

CASE I, Pilcher Clinic, No. 2962.—H. M. V., male, aged fifty-two years. Referred by Dr. S. S. Brown. Symptoms nine years ago after a severe attack of pain in left kidney region; reports having passed a small stone. Two years ago had three similar severe attacks accompanied by a temperature of 102° . During all this period has had intermittent aching pain in left kidney region. Developed a right hydrocele in 1915. Urine examination at various times has shown many hyalin and granular casts. At no time has he passed blood. Examination shows presence of an irregular, firm mass in upper left quadrant of abdomen, moderately tender, somewhat movable. Cystoscopic examination: Atresia left ureter, opening barely admitting a No. 3 bougie to the brim of the true pelvis, 26 cm. No urine was seen to escape from left ureter, normal flow from right. P. S. T., 60 per cent. (all from right kidney). Radiographic examination demonstrated the outlines of the tumor very distinctly. Pyelography was impossible owing to occlusion of left ureter. Operation, October 30, 1919. Longitudinal incision along left semilunar line with transverse extension into lumbar region. Two-thirds of the large mass was held firmly above the level of the costal border by adhesions to the diaphragm. At an advanced stage of the enucleation, the mass ruptured, inundating the field with old and fresh blood-clot and detritus. Imminent dissolution of the patient was met by immediate intravenous infusion into jugular vein and transfusion of 600 c.c. citrated blood, Group No. 4; reaction satisfactory. Clamp left applied to pedicle. Convalescence was delayed by the formation of a jejunal fistula, which eventually closed spontaneously.

CARCINOMA OF THE KIDNEY

Pathologic Report: Gross appearance showed a large varicose mass, size of adult head, partly evacuated of organized blood-clot; attached to the lower and inner part of this mass could be distinguished kidney structure surrounded by a greatly thickened capsule. *Cut section:* Markings indistinct, parenchyma waxy and pale—moderately dry. Pelvis greatly dilated and filled with organized blood-clot—its walls were rigid and showed encroachment on its surface of a malignant extension, which entirely surrounded it and extended half way through the parenchyma proper. The upper pole of the kidney was the seat of an extensive malignant process which at one point had broken through the capsule, with a subsequent extracapsular hemorrhage forming the major part of the tumor mass. The ureter was occluded by organized blood-clot.

Microscopic examination shows the structure of the tumor mass to be that of a papillary adenocarcinoma. The cyst wall shows connective-tissue proliferation containing some atrophic renal tubules and enveloping a mass of adenocarcinomatous tissue. There is also a large amount of infiltration with small round-cells.

In this history will be noted the complex of stone, infection, nephritis, stasis and carcinoma extending over nine years. The patient is in perfect health at the date of this report, sixteen months after operation.

CASE II.—Major M. C., male, aged fifty-nine years. Service of Doctor Sherwood at U. S. A. General Hospital No. 1. Well until one month ago. Sudden onset, chills and fever; urine showed hyalin and granular casts and pus. Leucocytosis of 15,800; polymorphonuclears, 81 per cent. Cystoscopic examination demonstrated complete occlusion of right ureter. First operation by Doctor Sherwood July 17, 1918, large cystic tumor evacuated of more than a quart of thick, brownish pus. Second operation, August 26, 1918, by Doctor Sherwood, removal of kidney, examination of which showed it to be the seat of a new growth, involving the entire pelvis and first three inches of the ureter. Uneventful recovery. Patient in perfect health at present time, two years and three months after operation. Pathologic examination showed it to be a papillomatous carcinoma of the kidney. There were no stones found. ANNALS OF SURGERY, 1919, vol. lxx, page 624.

CASE III.—W. F., male, aged thirty-six years. Surg. Service B. Brooklyn Hospital (No. 1288). Operator Doctor Westbrook. Symptoms: Sharp pain in left side and hæmaturia one and one-half years before examination, six months later, similar pain but no blood. Present attack began four days before admission. Pain left lumbar region steadily increasing, radiating down ureter, accompanied by frequent micturition, no blood. Operation, medium lumbar curved incision, kidney adherent at upper pole, blunt separation and removal. Pathological report shows moderately enlarged kidney 12 by 7 by 6 cm. Presenting on section a round, definitely circumscribed tumor in upper half, 7 cm. in diameter. The cut surface bulges, has a pale, yellow color with hemorrhagic areas scattered over it. Consistency soft and boggy. The lower segment projects into dilated crescentic-shaped calyx, connected with pelvis by a narrow opening, no stone. *Microscopic*

examination.—Papillary adenocarcinoma, probably originating in the renal parenchyma.

CASE IV.—M. C., male, aged forty-two years. Surg. Service B, Brooklyn Hospital (No. 1217). Operator Doctor Westbrook. Symptoms: Pain, severe, right loin five months ago. Lancinating, duration few minutes. Three days later noticed blood in urine. Attack of pain repeated three months ago, followed by passage of clot, but no calculus passed. Since has been passing blood intermittently without pain. Right kidney palpable, does not appear enlarged, not movable. Ureteral catheterization shows normal function left kidney and greatly diminished right kidney function. Operation: Angular lumbar incision. Kidney one-third larger than normal. Two nodules at upper pole and large projection into pelvis. Organ removed with difficulty, much hemorrhage. Pathological report shows growth to be of epithelial character. Diagnosis: Carcinoma right kidney. Subsequent history: Two and one-half months later a recurrent carcinomatous nodule was removed from the scar. There have been no other signs of recurrence to present (three years).

CASE V.—H. S., female, aged seventeen years. Surg. Service B, Brooklyn Hospital. Operator Doctor Westbrook. Symptoms: Two years before examination, had pain referred to epigastrium and a similar attack two months ago, with inability at each time to void. With subsidence of pain, a large quantity was passed strongly blood-tinged. The urine in the interim had been slightly bloody at intervals. For seven months had noticed a non-tender swelling in left side. Cystoscopy demonstrated the probable existence of an hydronephrosis, but not enough bromide solution was injected to detect the calyces. Operation, March 23, 1920. Nephrectomy, with rapid recurrence in two and one-half months. Microscopical diagnosis: Carcinoma of kidney.

CASE VI.—Seney Hospital (No. 942). Service of Dr. L. S. Pilcher. December 3, 1889. Mrs. S. D., aged fifty-three years. One and one-half years ago small lump first noted high in right iliac region. For six months dragging pain in right iliac region. General deterioration of health; nausea; occasional vomiting; loss of appetite and loss of strength and weight; flatulence. Urine, acid, 1013; albumen trace; sugar, 0; hyalin and granular casts, leucocytes. On admission to hospital there was a large, firm, slightly lobulated tumor occupying right half abdomen, slightly tender. Dulness continuous with liver. On exploratory incision the kidney, cæcum, and the mesocolon were found involved in a carcinomatous growth; no attempt at removal made; death fourteen weeks later. Autopsy: Whole kidney except upper pole involved.

CONCLUSIONS

1. Carcinoma of the kidney may develop from either the epithelium of the pelvis or from that of the renal tubules.
2. Its inception is apparently due to the presence of an irritating factor, as stone, infection, or stasis.

3. There appears in all cases examined some area of inflammatory process.

4. The neoplastic tissue seems to develop not at the point of irritation, but peripheral to the round-cell inflammatory reaction, one process merging into the other.

5. Cystoscopy is absolutely essential in every case of hæmaturia to ascertain the source of bleeding. It is not a symptom which allows of procrastination in determining its etiology.

6. If from either or both kidneys, a pyelogram should be made if possible.

7. Exploratory operation should be performed if there is any question of the diagnosis.

8. Early recognition has been rare, and the prognosis is correspondingly grave.

CARCINOMA OF THE PELVIS OF THE KIDNEY

BY ALEXIUS MCGLANNAN, M.D.

OF BALTIMORE, MD.

TUMORS derived from the epithelium of the pelvis of the kidney are much more uncommon than growths having their origin in the more highly specialized epithelium of the parenchyma of this organ. Watson and Cunningham had only one tumor of the pelvis in a series of ninety-eight growths involving the kidney. At the 1913 meeting of the Southern Surgical Association L. B. Wilson reported four tumors of the collecting portion of the kidney among ninety-two renal tumors (*ANNALS OF SURGERY*, 1913, lvii, 522). McGown (*Jour. Amer. Med. Assoc.*, October 30, 1920, lxxv, 1191) reports forty-eight cases of papilloma of the pelvis of the kidney, which number includes a case of his own, two previously unreported cases of other observers, and the remainder found in an exhaustive study of the literature. In the discussion of McGown's paper eight more cases were reported, including that of Stevens (*Jour. Amer. Med. Assoc.*, June 5, 1920, lxxiv, 1576).

Practically all of the tumors of the renal pelvis have a papillary structure, and in their onset are benign. A few reported tumors seem to have originated in flat masses of squamous epithelium, probably in an area of leucoplakia. The papillary tumors, like those of the bladder, have a marked tendency to malignant change. Such malignant change is certain to follow an incomplete removal of one of these tumors. Although in some of the reported cases the tumor has been present several years and apparently has retained its benign qualities, all these tumors are potentially malignant, and should be treated with this fact in mind.

When the papilloma becomes malignant the architecture of the tumor is reproduced. As such a tumor becomes older, the papillary arrangement will be lost in the deep infiltrating areas, and here the epithelial cells become diffuse as medullary or scirrhous carcinoma. The infiltrating tumor almost invariably grows into the parenchyma of the kidney and the cortex may be perforated.

Secondary growths seem to be produced by implantation. In this way the occurrence of complicating tumors down the ureter and in the bladder may be explained. Metastases by way of the perirenal lymphatics involve the upper lumbar lymph-nodes about the aorta and vena cava. Late metastases occur in the liver and the lungs, but rarely in the bones.

No definite relation can be found between the development of the papillary tumors and the presence of stone in the kidney. That leuco-

plakia may be the result of calculus irritation and in turn be the source of a squamous-cell tumor is a possibility. There is great difficulty in studying the reported cases, because in very few incidences has the type of the tumor been definitely described.

Nephrectomy is required for the removal of these tumors. The ureter should be carefully investigated and as much of this organ as is indicated should be removed because of the danger of an implanted growth in its lumen. In many cases complete nephro-ureterectomy should be done. Some authorities believe the latter should be the operation of choice in all cases.

The symptoms of papilloma of the renal pelvis are fairly typical. Hæmaturia is almost constant, and the quantity of blood lost may be sufficient to disable the patient. There is some blood in the urine almost all the time, and at intervals profuse hemorrhage occurs and may persist for days or weeks. The profuse bleeding is usually preceded by colicky pain and this intermittent hæmatonephrosis is considered a characteristic symptom (Israel, quoted by Ransohoff, "Keen's Surgery," vol iv, p. 247). The presence of transitional epithelium in the urine is a valuable corroborative symptom.

The kidney is seldom enlarged by the growth and therefore a palpable tumor is not present. An accompanying renal calculus may be shown by the X-ray. After collargol or similar injections which visualize the kidney pelvis and calyces, the X-ray shows alteration in the outline of the pelvis or some other deformity of this part of the kidney, varying in extent with the size of the tumor.

Cystoscopic examination will show the condition of the bladder, and the side from which the blood comes. Catheterization of the ureter permits segregation of urine for functional tests. The function of the involved kidney is usually impaired.

The differentiation from essential hæmaturia is not always easy. The bleeding from a tumor will not be controlled by the measures which are effective in essential hæmaturia, and in this lesion the deformity of the pelvis, as shown by X-ray, does not occur. Alteration in the function of the kidney, which is common with tumor, does not take place with the essential hæmaturia.

The case which I now report makes fifty-seven on record at this time, and is the eighteenth American case.

B. S. H. No. 228. The patient, a white man, aged sixty-seven years, was admitted to the Bon Secours Hospital, Baltimore, February 22, 1920. He was referred by Dr. W. A. Glines, of San Juan, Porto Rico.

The patient complained of persistent hæmaturia, weakness and shortness of breath. The hæmaturia had been almost constant for

two and one-half years. There were occasional short periods when the urine seemed free from blood. After these periods he would have an attack of colicky pain in the region of the left loin, which would gradually subside as the bleeding returned. These attacks of intermittent hæmatonephrosis took place about once in three months. At the onset he had frequency of urination with some obstructive symptoms. An enlarged prostate was removed two years ago. After this operation the bleeding subsided for about a month. Thrombo-plastin and other coagulants were given at intervals during the next two years, but without effect. In January, 1920, Doctor Glines found transitional epithelium in the urine.

Physical examination, made on admission to the hospital, was negative, except for great pallor, a loud murmur at the base of the heart, palpable radial arteries, and a little tenderness over the left kidney. The urine was a claret color, containing many red blood-cells, but no casts. The blood count showed 3,100,000 red cells with 50 per cent. hæmoglobin, but no abnormal cells. Wassermann reaction negative.

Cystoscopic examination (February 25th) by Dr. A. G. Rytima proved the bladder normal, and showed the blood coming with each spurt of urine from the left ureter, while the right side sent out clear urine. The patient was quite worn out when the examination had reached this stage, and therefore the ureters were not catheterized. X-ray examination was negative for stone. Because of the large amount of blood in the urine, the phthalein test was unsatisfactory, but the blood urea was found to be .48 gram. per litre.

A diagnosis of papilloma of the pelvis of the left kidney was made on the following points. There was bleeding from the left ureter, with attacks of intermittent hæmatonephrosis. Transitional epithelium had been found in the urine. The bladder was clear. X-ray did not show a stone. There was no palpable tumor. Hypernephroma or other tumor of the parenchyma, of two years' duration, should have made a large mass.

On February 29th, Dr. J. A. Ward gave the patient a transfusion of 500 c.c. of blood by the citrate method. On March 5th the red cells were 3,860,000 and the hæmoglobin 60 per cent. A second citrate transfusion of 550 c.c. was given by Doctor Ward on March 6th, and the next day the red cells were 4,000,000 with 65 per cent. hæmoglobin. A son of the patient was the donor on both occasions. Neither transfusion was followed by any disagreeable reaction.

Operation (March 9th).—McGlannan. Anæsthetic, ether; S. G. Davis. The left kidney and four inches of ureter were removed by lumbar nephrectomy. To avoid transplantation in the wound, the cavity was packed with alcohol sponges during the delivery of the kidney and before closing was flushed with alcohol. The wound was closed with a cigarette drain.

The post-operative course was uneventful and the patient was



FIG. 1.—The kidney opened out to show the cauliflower-like tumor filling the greater part of the pelvis and infiltrating the parenchyma (Photographs by Mr. H. Schnapire).

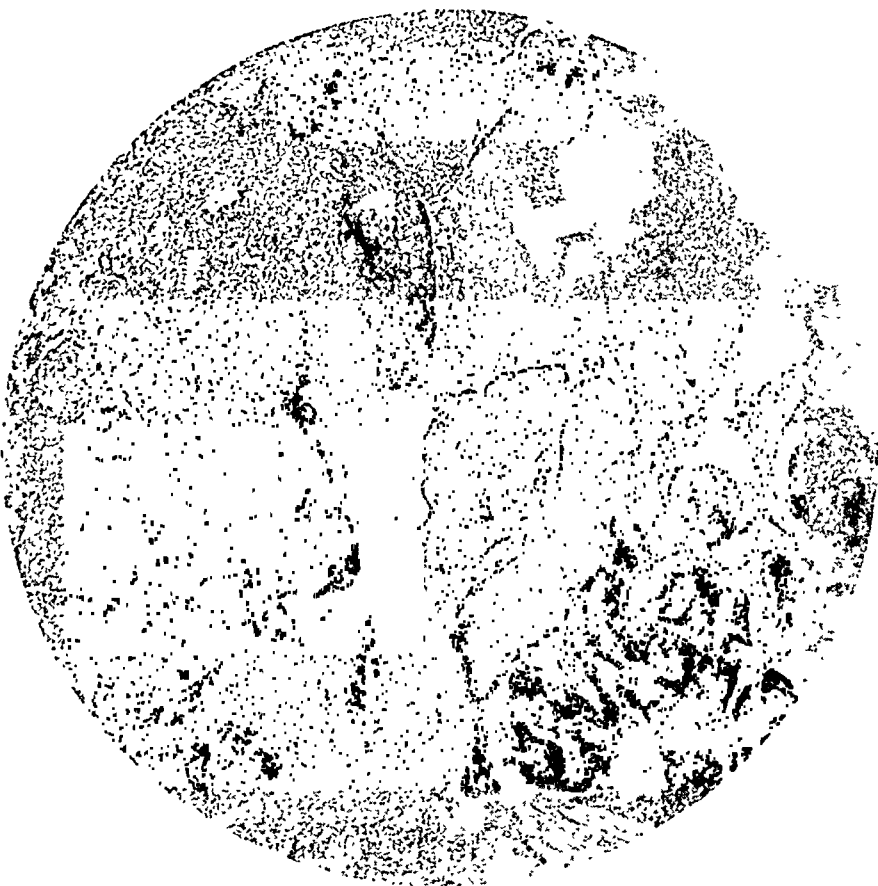


FIG. 2.—Low power photomicrograph of the papillomatous area.

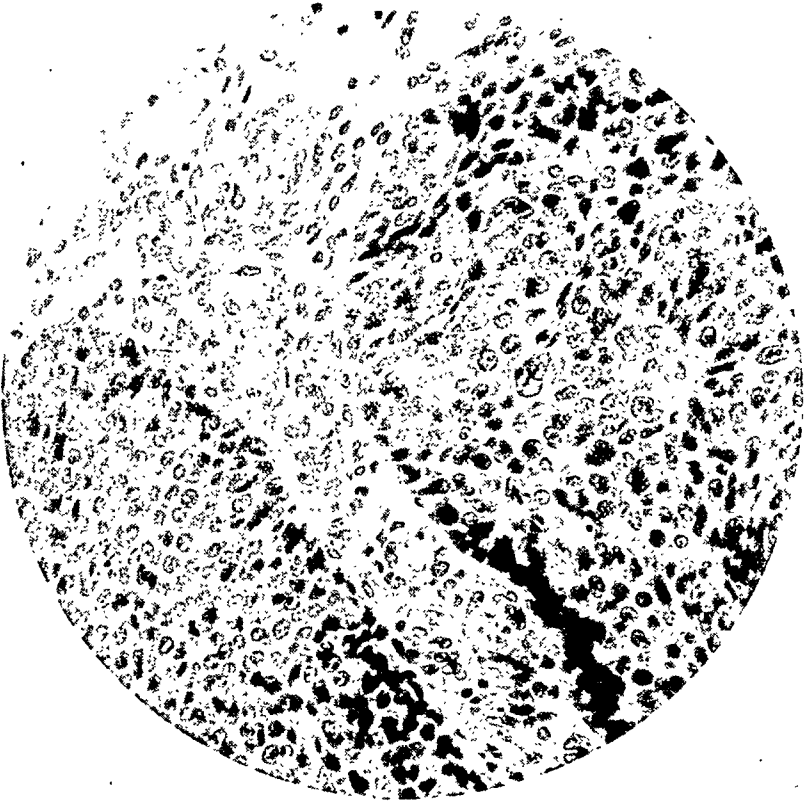


FIG. 3.—High power photomicrograph to show the type of cell.

discharged April 2nd free from symptoms. He is now well nine months after operation.

Gross Pathology.—The kidney is small and the cortex narrow. The cauliflower-like growth occupies the entire lower half of the pelvis and branches out into the upper half. The base of the papilloma is hard, definitely malignant, and infiltrates the parenchyma of the kidney almost to the capsule. The tumor, however, is clearly confined to the kidney. The ureter is free from any growth or extension.

Microscopic Pathology.—The papillomatous structure of the tumor is preserved in the greater portion of the section, but several areas of epithelial cells are found in irregular nests without any definite arrangement, making their portion of the growth medullary carcinoma. There are no squamous cells nor areas of cornification. The tumor, therefore, is a malignant papilloma becoming medullary carcinoma.

END-RESULTS OF OPERATIONS FOR BONY ANKYLOSIS OF THE JAW*

BY WILLIAM PHILLIPS CARR, M.D.
OF WASHINGTON, D. C.

IN 1916 I reported to this Society three operations for complete bony ankylosis of the jaw. Since then I have operated upon three more, and the results have been so good, as well as the end-results in those reported four years ago, that I feel that I should put them on record. Particularly so, because the impression seems still to exist that these cases are hopeless. At least, five of my patients had been told by surgeons of considerable experience that nothing could be done.

The fact that the operation is one of the most satisfactory in surgery, should now be generally known, for the condition is not extremely rare and many patients are still going without relief because they have been told it was impossible.

The operation, while not really difficult, should not be lightly undertaken by those who have not had considerable experience with bone surgery and who have not made a careful study of the subject and of the individual upon whom he is to operate. For the mechanical difficulties are greater than would appear on the surface, and many surgeons, excellent in other lines of work, would find themselves puzzled or even non-plused when operating for the first time on bony ankylosis of the jaw.

There are numerous important structures in close proximity to the field of operation, among which may be mentioned the parotid gland, Stenson's duct, the facial nerve, temporal internal maxillary and carotid arteries. The depth of the ramus of the jaw, its width, thickness and hardness, and the entire absence of any demarcation between the jaw and the base of the skull, as well as the obliteration of other landmarks, will be a surprise to anyone operating for the first time (see Fig. 1).

However, by using the instruments and method devised by Doctor Murphy, and a suitable drill for cutting the bone, the operation can be done with comparative ease and with safety. The Murphy operation and instruments have been well described by Kreuscher in the *Interstate Medical Journal* for October, 1916, and I shall not describe it here, but my further experience has taught me some accidents that are prone to occur and the way to avoid them, and I wish to put them on record for the benefit of others.

1. The temporal artery can be felt and located and the vertical incision made just anterior to it.
2. The horizontal arm of the incision may be made along the

* Read before the Southern Surgical Association, December, 1920.

lower border of the zygoma instead of the upper border, as recommended by Murphy, and still be above and parallel to the main temporofacial branches of the seventh nerve, and may be carried down to the bone with one sweep of the knife. No important structure will be cut.

3. To get one's bearings, make a careful dissection at the anterior end of the horizontal limb of the incision, drawing down the wound until the anterior border of the ramus can be felt and freed sufficiently to get a Murphy retractor under it (see Fig. 2).

4. The parotid gland in all my cases projected over the ramus almost, or quite, to its midline, and can hardly be distinguished from the fat and connective tissue lying in that region. In my first

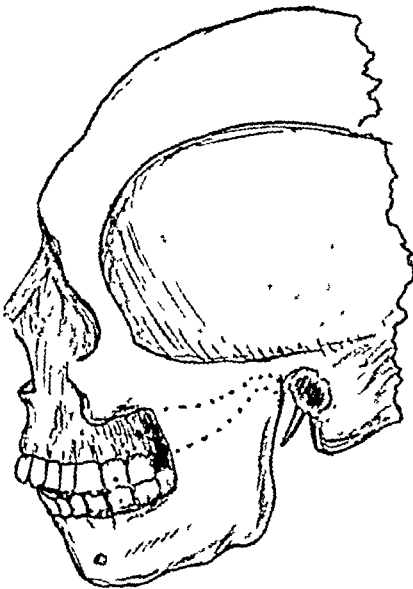


FIG. 1.—Shows the solid ankylosis and total lack of any line of demarcation between jaw and skull found in all my cases. Dotted lines show the bone to be cut away, leaving a rounded point for articulation.

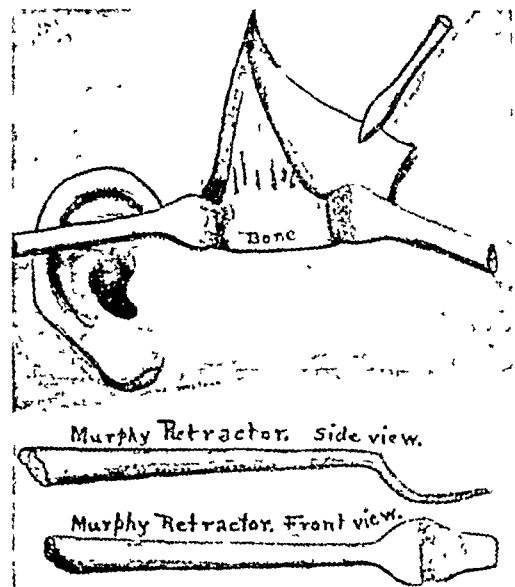


FIG. 2.—Shows the bone exposed and isolated by the retractors.

four operations I injured or cut into it three times with a salivary fistula as the result. Although these fistulas all healed spontaneously in from three to eight weeks, they were very annoying for a time, and necessitated frequent redressings.

This accident may be almost certainly avoided if the operation is begun as recommended above and the subsequent dissection made by lifting up all tissue over the bone *en masse*—keeping close against the periosteum until the posterior border of the ramus is reached, the only incision *through* these tissues being a deepening of the original skin incision over the lower border of the zygoma and well above any important structure.

The second Murphy retractor may then be inserted under the posterior edge of the ramus until it meets the first one behind the centre of the bone.

5. The bone is then found to be completely isolated in the region to be divided by boring a chain of $\frac{5}{8}$ -inch holes through it with my cranial drill (see Fig. 3) and connecting them with a gouge chisel, cutting away the bone as shown in the dotted lines in the accompanying Fig. 1.

The bone should be gouged out without hammering, and this can be easily done if the holes are bored close together. This can be done more easily and more quickly than division with a Gigli or other saw, and allows a shaping of the bone as indicated by the dotted lines in Fig. 1. It also takes out a thicker section of bone than a simple saw cut, and I believe this is a good thing in preventing pressure on tissue interposed between the cut ends. I have always opposed the use of a chisel and mallet upon the skull, particularly the base of the skull, near the mastoid and maxillary articulation. We all know how easily one may be knocked out by a slight blow on the chin, and I have seen cases of severe and even fatal shock following a vigorous use of the mallet and chisel, that I be-

lieve were due to this cause.

By use of the Murphy incision and the careful dissection above recommended the facial nerve will not be injured and bleeding avoided as well as the danger of injury to the parotid or Stenson's duct.

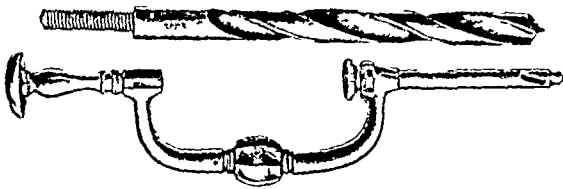


FIG. 3.—Cranial drill.

In most cases where the affection is one sided, the mouth will open readily after division of the bone, even when the case is of long standing.

In some, however, particularly where both sides have been affected, the masseter, pterygoids, and other muscles have become so contracted that even with considerable force the teeth cannot be separated more than one-half or three-quarters of an inch. Great care should be observed in prying open the mouth in such cases, as the teeth, probably from long disuse, have a very slight hold in the jaw and are very easily shelled out like grains of corn from the cob. It is better to hold the head firmly and depress the chin until a mouth gag can be inserted between solid molars—rather than attempt to pry open with any instrument between the front teeth, or better still, to depend upon expansion screws to be used later between molar teeth.

I do not favor the interposition of any extraneous substance between the divided bones, although I know that Baer, of Baltimore, has had excellent results in this way. If a rather wide section of bone (five-eighth inch) is removed and the articular end shaped to a rounded point, I do not believe this is necessary. The greatest danger of recurrence would seem to be from callus forming and attaching the anterior border of the ramus to the zygoma, and I believe this is avoided by cutting out more bone anteriorly.

This has been proved, I think, by the end-results in my first three cases where nothing was interposed. However, in doing the Murphy operation, it is so easy to turn down a flap of temporal fascia that I favor it as an extra precaution, and have done it in the last three cases.

In conclusion, I would say that the results in my first three cases, after a period of four to six years, are all that could be desired. They have all been recently heard from and are able to separate the front teeth an inch or more, eat without difficulty, and are highly pleased. In the last three there were no accidents and the results so far are very satisfactory.

A brief record of all my cases is appended.

CASE I.—I. E., male, Italian, aged thirty-seven years. Admitted to the Emergency Hospital July 26, 1915. *Previous History.*—When about twelve years old the patient had a fall, striking his chin and injuring his jaw. Since that time he has been unable to open his mouth or chew solid food. Until five years ago there has been very slight movement in the joint; but he was able to eat only by putting food in through a gap where two incisor teeth had been removed, and mashing it with his tongue against the roof of his mouth. But for the last five years there has been no motion at all of the jaw.

Present Condition.—Rather small man, fairly well nourished and normal in all respects except the absolute rigidity of the jaw and the retracted chin, which always follows injury to the neck and head of the mandible. He is extremely anxious to have an operation done for his relief, and says he would rather be killed than live in his present condition. Röntgenograms showed a massive bony ankylosis of both sides.

Operation (July 28, 1915).—A vertical incision was made a half inch in front of the auditory meatus extending from the upper border of the zygoma downward about an inch and a half. From the upper angle, the incision was carried transversely across the cheek for an inch and a quarter. The bone was exposed, care being taken to avoid the parotid gland and Stenson's duct. It was impossible to find any line of demarcation between the ramus and the zygoma, or base of the skull. The ramus was an inch and a half wide and was finally exposed low enough down to find a free edge anteriorly and posteriorly. A flexible retractor was then inserted under the ramus and it was cut away with gouge chisels without hammering, and pointed at the articular side somewhat like the normal head and neck. A flap of periosteum was turned down from the zygoma and inserted between the cut bone surfaces. The same operation was then done on the other side; but a piece of the parotid gland was cut off and the internal maxillary artery wounded by a slight slip of the chisel. Bleeding was controlled temporarily by gauze packing, and after the bone had been cut away the artery was tied by passing catgut in a small curved needle under it. The periosteum was so thin over the zygoma that no satisfactory flap could be obtained. The wounds were closed and the jaw found

slightly movable but still quite rigid on account of muscular contraction. Attempting to pry open the teeth resulted in knocking out three or four before it was found that they were extremely loose from disuse and shelled off as easily as grains of corn from a cob. Finally a mouth gag was placed in between two moderately firm molars and an inch cork put in between the jaws in front.

The next day this cork was removed and it was found that the patient could open and close his jaw to the extent of about a half an inch. Later by the use of gradual dilatation with ordinary lead expansion screws such as are used by carpenters, the range of motion was increased to one inch, and when last seen sixteen months after operation the range was one and one-fourth inches.

Cutting the parotid gland caused a salivary fistula on one side which did not completely heal for seven weeks; otherwise convalescence was normal and the scars, when last seen, were hardly noticeable.

CASE II.—D. D., white male, single, aged thirty-two years. Admitted to the Emergency Hospital on February 12, 1916. *Previous History.*—When about ten years old, the patient fell from a cherry tree striking on his chin. After recovery from the acute injury the jaw was very stiff and sore, and this rigidity increased until he was unable to eat solid food. A year or so later he was taken to a hospital where the jaw was opened forcibly under an anæsthetic. This gave temporary relief, but in a few months the condition was worse than before. Several years later he was again taken to the same hospital and another attempt was made to break up the ankylosis by forcible dilatation under ether. This time the attempt was not successful and several teeth were knocked out in the attempt to pry open the jaw.

After that there was complete immobility. As in the previous case, food was introduced through a space left by the loss of an incisor tooth and masticating with the tongue.

Condition on Admission.—Tall, slender, very intelligent young man, with the usual receding chin and complete immobility of the jaw. He was pale, not very well nourished, and very sensitive about his condition. An excellent series of röntgenograms was made by Dr. Thomas A. Groover, showing the usual bony mass about the mandibular articulation on the right side; but the left articulation seemed nearly normal. The chin was drawn slightly toward the affected side, and the cheek on that side was fuller and more rounded. This corresponds to Doctor Murphy's observation that the best-looking side is the affected one, in unilateral cases. This is due to the shortening of the ramus at the point of fracture or disease. The patient had several badly decayed teeth, but had never had toothache.

Operation (one hour after admission, February 12th) was similar in all respects to that described in Case I, except that it was done on the right side only, and without accident of any kind except cutting off a small piece of the parotid. The operation was much

facilitated by passing the curved handle of a bone forceps behind the ramus, first on one side and then on the other, and boring out the bone with my cranial drill. No flap was interposed, but the articulating end of the ramus was cut to a rounding point. After section of the right side the jaw was found movable and pried open about an inch, very carefully with a pair of Goodell uterine dilators, one on either side between the molar teeth. This was done to stretch the muscles which were much contracted.

After-treatment.—There was no special after-treatment for a week. Then I turned the patient over to my dentist, Dr. A. B. Cooper, who gave him the expansion screws and later small dental jack screws and taught him how to use them himself, and how to tighten them up a little more each day as the muscles relaxed. He wore them mainly at night, with a silk thread attached to prevent swallowing them during sleep. At the end of three weeks he could open and close his mouth without discomfort, almost to a normal degree. The range of motion is now an inch and a quarter, and the patient has a new set of teeth. The wound healed readily, except for a small salivary fistula which persisted for six weeks but did not necessitate confinement. The patient sat up on the third day and was comfortable and was discharged from the hospital on the tenth day after operation. He is now well, eating without difficulty and about the most pleased patient I have ever had.

CASE III.—Miss D. J., female, white, aged twenty-two years, single. Patient of Dr. A. R. Shands. Admitted to the Emergency Hospital September 14, 1916. *Previous History.*—The patient had had an acute suppuration of middle ear following measles when four years old. The ear-drum burst and drained for some weeks and was followed by soreness and stiffness of the jaw, which finally became fixed and has remained so for eighteen years.

Condition on Admission.—A very intelligent young lady, of medium size, well nourished, but with soft muscles. No teeth had been lost, but the lower jaw was so much retracted that the lower incisors were half an inch back of the upper incisors, leaving a gap through which food was introduced. Jaw absolutely rigid. Chin drawn slightly to right side and right cheek fuller than left. Röntgenograms made by Doctor Groover showed heavy mass of bone about right mandibular articulation and left joint apparently normal.

Operation (September 15th) by Doctor Shands, with my assistance. Doctor Shands attempted to operate through a straight transverse incision over the zygoma, but was obliged to make an L running down a half inch in front of the ear in order to get sufficient room. The bone was cut as in the previous cases with cranial drill and gouge chisel, without hammering, and trimmed with bone forceps. Immediately on section of the bone there was a wide separation and the mouth opened easily an inch and a half. A small piece of parotid gland was cut off in spite of our care to avoid it. No flap was used between the cut bone surfaces.

After-treatment.—No special after-treatment was used. The

muscles were not contracted as in the previous cases and the young lady was able to eat in a few days without discomfort. The wound healed readily except for a small salivary fistula which had almost entirely healed when she returned to her home in North Carolina in November, 1916.

I advised Doctor Shands to teach her to use the expansion screws and have her use them on the slightest sign of recurrence, but so far it has not been considered necessary.

CASE IV.—L. C., male, white, aged twenty-seven years, single. Referred by Dr. Thos. Grasty, September 19, 1917. *Previous History*.—A fall on the chin when five years old. Jaw has been rigid ever since he can remember. Usual deformity.

Condition on Admission.—Complete fixation of the jaw with the usual deformity seen in one-sided cases. Murphy operation at the Emergency Hospital September 22, 1917. Flap of temporal fascia stitched between the severed bones. Rigid muscles stretched with mouth gag between molar teeth. Primary union. Patient reported September 30, 1920, three years after operation. Result excellent. Opening one and one-quarter inches.

CASE V.—Female, colored, aged eighteen years, single. Referred by Doctor Bailey. *Previous History*.—Fall on chin when fourteen years old. This was followed by severe pain, soreness and swelling of jaw on left side.

Condition on Admission.—Stiffness increased gradually to complete rigidity in about a year. Usual deformity. Murphy operation at the Emergency Hospital April 12, 1918. No accident or complications. Mouth opened easily. Result excellent after two and one-half years.

CASE VI.—Miss A. J. N., white, single, aged thirty-seven years. *Previous History*.—Abscess near the maxillary articulation following diphtheria, when a small child.

Condition on Admission.—Seen first in September, 1920; had the usual rigidity and deformity; jaw rigid ever since she could remember. Has very bad teeth with abscess at the roots of several and X-ray shows two impacted molars on the affected side. Upon consultation with her dentist, Dr. A. B. Cooper, it was decided to remove all her teeth at the time of operation.

Operation at the Emergency Hospital, October 18, 1920. Murphy operation. Extraction of teeth by Doctor Cooper. No accident or complication except that the teeth were very difficult to extract. Several broke off and the roots were dug out with an elevator. She complained greatly of pain where the teeth were extracted for some time and of great soreness of the gums. Also complained of a discharge from the ear, which Doctor Piggott (her ear specialist) said was due to an old middle-ear disease with perforation of the drum. She had no pain in the operative wound which healed *per primam*. She was much pleased with the result of operation and when last seen, a month later, had quite free movement.

LARYNGEAL FUNCTION IN THYROID CASES*

BY EDWARD STARR JUDD, M.D.

OF ROCHESTER, MINN.

THE larynx takes part in two functions, phonation and respiration. Phonation is brought about largely by the adductor muscles of the vocal cords which in contracting approximate the cord in the midline. During normal respiration the vocal cords are held apart by the abductor muscles (Figs. 1 and 2). All the intrinsic muscles receive their nerve supply from the recurrent laryngeal nerve and any disturbance in the function of the larynx is apt to be the result of some form of disturbance of this nerve. It is situated so that it is exposed to pressure from aneurisms in the upper portion of the chest and to pressure from enlarged lymph-glands, and as a result of this pressure it is not uncommon for the nerve on one side to become partially or completely paralyzed. In the absence of any pressure or trauma this nerve may be paralyzed occasionally, probably as a result of some toxic influence. Because of the gradual onset of this form of paralysis the patient may not be aware of any change in the function of the larynx and may continue to speak and breathe in a normal manner. This is explained by the fact that as the muscles of one vocal cord become less active because of the interference to their nerve the muscles of the opposite cord increase their function, enabling the normal cord to make excursions across the midline of the larynx and approximate the cord at that point. So long as the change is brought about gradually the patient is not aware of it, but if one side is paralyzed suddenly loss of voice and difficulty in breathing will be experienced until, by repeated efforts, the muscles of the good cord bring it across to an exaggerated position. Matthews, working in our clinic several years ago, found that a small percentage of patients on whom he made laryngoscopic examinations had almost total paralysis of the vocal cord, and that in addition a larger percentage showed some paresis of one cord. This occurred in patients in whom there was no enlargement of the thyroid and who were totally unaware of any change in laryngeal function.

As the recurrent nerve passes upward in the groove between the trachea and the œsophagus and reaches the region of the thyroid, it becomes intimately associated with the posterior capsule of the thyroid gland and in reality is compressed between the gland and the tracheal and cricoid cartilages. It can be seen readily that any enlargement in the thyroid is apt to make pressure on this nerve and that if the pressure becomes great enough it may cause disturbance in function. The size

* Read before the Southern Surgical Association, December, 1920.

of the gland is not always accountable for the pressure, for there may be no sign of disturbance in the case of a large tumor, and a marked disturbance may result from a small goitre placed so as to exert the greatest pressure on this nerve. Paralysis of the recurrent laryngeal nerve

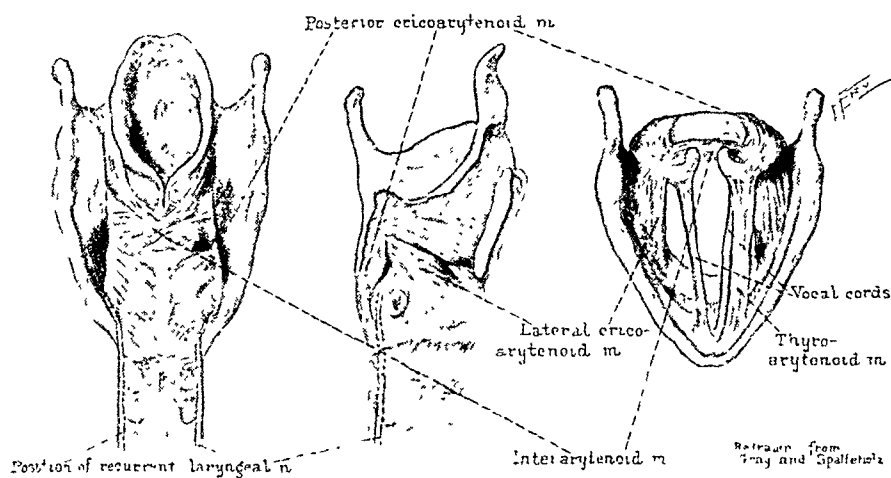


FIG. 1.—Muscles of the larynx.

Redrawn from
Ingalls and Barlow

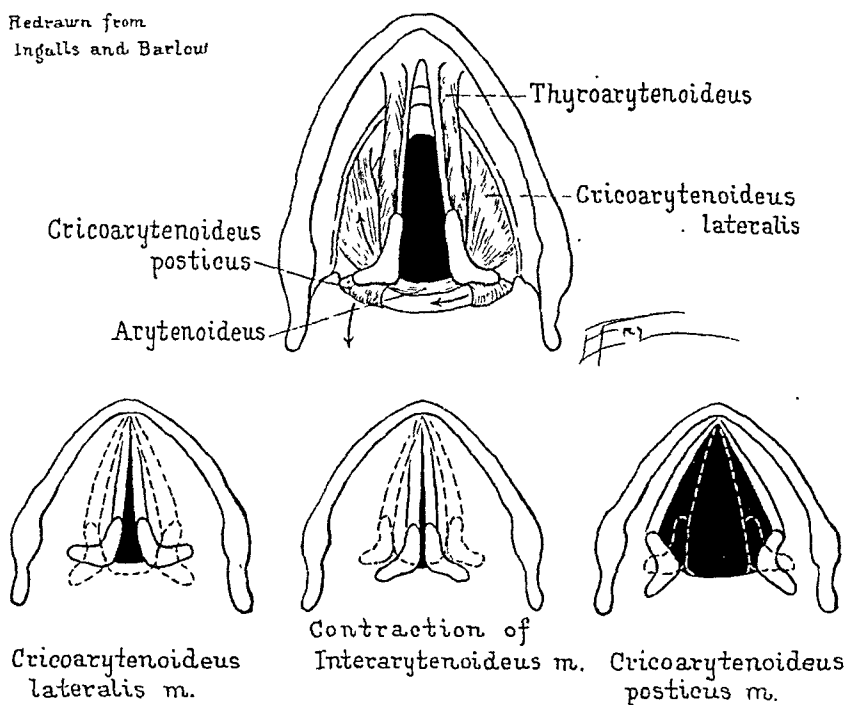


FIG. 2.—Action of the muscles of the larynx.

caused from a goitre apparently occurs in somewhat more than 5 per cent. of all patients with goitre. A very interesting condition occurs in a smaller percentage of cases, namely, a paralysis in the nerve on the side opposite the enlargement. A large adenoma of the right lobe may

cause a marked displacement of the larynx and trachea, and if the proper amount of pressure or stretching is exerted on the opposite nerve paralysis is produced.

When we realize that a certain number of persons without disturbance of the thyroid have paralyzed vocal cords and also that a patient with goitre may have paralysis on the side opposite the enlargement, the importance of a careful laryngoscopic examination before operation for goitre becomes evident. If a patient is depending on one cord for phonation and normal respiration it is important to protect that cord.

Total loss of voice in association with enlargement of the thyroid is due to one of two conditions, hysteria or carcinoma. At least I have not seen a case in which benign enlargement was the cause of bilateral paralysis. If the condition is due to hysteria, some motion of the cords will be discernible with the laryngoscope, and this motion is due to the adductor contractions. If the cords are completely paralyzed the condition is almost certain to be carcinoma. In benign enlargement we have to deal only with pressure and stretching of the nerve and with disturbances of the intrinsic muscle from these causes; in malignant disease the process is not confined within the capsule of the thyroid, but involves the nerves and causes an actual destruction of nerve tissue which results in a total paralysis.

Temporary disturbance in the voice and respiration is not uncommon following thyroidectomy (Guthrie). I believe that the loss of voice soon after operation may be due to one or more of the following factors:

(1) A change in the position of the muscles and cartilages because of the shifting of a misplaced larynx back into its normal position; (2) œdema of the tissues; (3) a true myositis; (4) trauma to the recurrent laryngeal nerve; and (5) prolonged interference with function.

1. *A Change in the Position of the Muscles and Cartilages Because of the Shifting of a Misplaced Larynx Back into its Normal Position.*—In several cases in which an adenoma was large and situated so as to push the larynx off at a right angle, no view of the larynx could be obtained with the laryngoscope; I noticed that when the tumor was removed and the larynx allowed to return to its normal position the voice was lost immediately and returned to normal in from a few days to a few weeks.

2. *Œdema of the Tissues.*—This is more marked in some cases than in others, and is, I believe, less common now than formerly, because we realize the importance of keeping the line of dissection farther away from the trachea and larynx and of saving more tissues about these structures to prevent the swelling from extending to the mucous membranes.

3. *A True Myositis.*—Myositis may result from trauma to the muscles and cause limitation of motion of the vocal cords, or an ankylosis of the joints between the cartilages of the larynx may occur. The delicacy of the laryngeal structures makes it impossible to determine just how often these lesions occur.

4. *Trauma to the Recurrent Laryngeal Nerve.*—I am under the impression that the nerve is more often injured at the point of entrance into the larynx than at the point of crossing the inferior thyroid artery. The nerve is seldom severed, but it may be pinched in the hæmostat with other tissue or it may be caught in a ligature in tying a vessel.

In 1917, Mann, New, and I traumatized the laryngeal nerves in dogs to study the return of function. In twenty-four cases the nerve was pinched and all the cords were paralyzed. After pinching the nerve at the lower pole of the gland the function was restored in about sixty days, after pinching it close to the larynx function was restored in thirty days. In all cases there was complete restoration of the laryngeal function. In another series of nineteen cases the nerves were ligated. Plain and chromic catgut and silk for the ligatures were used, and in each instance immediate and complete paralysis occurred. These dogs were observed for one hundred and sixty days; during this time there was no sign of any return of function. In several instances in this series the nerve was severed, always with complete and permanent paralysis. In nine of the series the nerve was stretched for a few minutes, but in one case only was there any paralysis from this procedure. In four cases the nerve was stretched by suturing the muscles under them, thus producing a permanent constant stretching. In three of these paralysis occurred.

It seems to me that these experiments gave results that would be expected; that is, that if the nerve is severed or tied tightly, even with catgut, the ensuing paralysis will probably be permanent and the function will be disturbed until it can be compensated by the increased efforts on the opposite side. If the nerve is pinched or stretched or explored, the paralysis will be temporary and the function restored by recovery of the traumatized nerve.

Injury to the superior laryngeal nerve naturally is an uncommon occurrence. This nerve supplies sensation to the mucous membrane of the larynx and a branch to the external muscles which, in contracting, make the cords tense. An injury to this nerve would produce a numbness in the larynx and a lax cord with a deep, coarse voice.

The complete restoration of phonation and respiration to normal occurs with restoration to normal of the muscle and cord on one side. Even if the nerve has been severed or destroyed completely, or if one cord has been removed, the function eventually returns, due to the compensatory efforts of the uninjured cord, so that while any trauma to a recurrent nerve is serious, the effects so far as function is concerned will be only temporary. Serious results occur if the only nerve that is functioning is interfered with or if both nerves are traumatized. We have performed a great many thyroidectomies during the course of a number of years, and have observed many patients with some disturbance of phonation, of respiration, or of both at various periods, often within a few days after the operation, but the voice and breathing have always returned

to normal except in a small group of cases. In a few instances some evidence of trouble persisted for a month or more, but finally ended with a normal laryngeal function. These patients are restored to normal voice through the increased efforts of the normal cord. In cases of paresis recovery occurs.

5. *Prolonged Interference with Function.*—A small group of cases of bilateral abductor paralysis (twelve cases) prompted this study of laryngeal function. The voices of these patients are usually normal or may be very slightly impaired; the principal disturbance is in respiration. In approximately 25,000 thyroidectomies we have had nine patients with this trouble; three others were observed who were operated on elsewhere. A few scattered cases have been mentioned in the literature. It is interesting to note that this condition has been observed independent of any condition of the thyroid, and in such instances was believed to be due to toxic influences (Gleitsmann²). Bilateral abductor paralysis is not uncommon with syphilitic and tabetic conditions. It is possible that some of the cases of complete dyspnœa which occur at the time of the operation or a few days afterward are due to recurrent paralysis, although if the paralysis is complete there will be no trouble in breathing. These occurrences are rare, although at times they are severe enough to require immediate tracheotomy. After the acuteness of the symptoms has subsided, usually within a few days, the tracheotomy tube can be removed, and the opening in the trachea allowed to close. The return to normal of the voice and respiration will take place in a short time. These cases may or may not be due to disturbance in the cord, but the onset of the condition is so abrupt that no time can be taken for laryngoscopic examination.

The onset in these twelve cases of bilateral abductor paralysis was gradual. The immediate convalescence from the operation in this group was not unusual, except that the voice was weak and husky. In some of the cases there was paresis of the cord after the operation, although it was not sufficient to produce a noticeable change in the voice or in breathing, except in two or three cases. In a few cases there was some hoarseness and huskiness immediately after the operation. At the end of four or six or even eight weeks dyspnœa appeared and gradually increased. The voice remained normal. The degree of dyspnœa varied. Although usually a tracheotomy does not seem necessary, in four of these cases the margin of safety for a sufficient amount of air was considered so slight that operation was performed in two cases in the clinic and in two cases elsewhere, one after six months, one after seven months, and one after fourteen months following the operation. The paralysis, if it is a paralysis, is confined to the posticus muscles which are the abductors of the vocal cords. New has demonstrated that there is no ankylosis of the joints of the cartilages. We have not been able, however, to show that there is not a myositis in this muscle. The paralysis occurred for the most part in cases in which the adenomas were retrotracheal or retrolaryngeal, in which case the recurrent laryngeal nerve is liable to be in the field of

operation; also possible that in the removal trauma occurred to the posterior tissues of the larynx. Although it seems that this condition must be the result of some change in the nerve to these muscles it is difficult to understand just how it can occur. Any manner of traumatizing the superior or inferior laryngeal nerve in dogs does not produce a condition anything like a bilateral abductor paralysis. Because the onset is late the explanation has been offered that the contraction of scar tissue produces pressure on the recurrent. This is entirely feasible, since the fibres of the recurrent laryngeal nerve which supply the abductor muscle are known to be the most vulnerable part of the nerve. The condition, however, is bilateral and always of the same degree on both sides. In some of the cases almost all of the operative work was on one side only, so that there was no chance of trauma to both nerves, and it seems unlikely that the same amount of scar tissue should occur on each side. New has suggested that at the time of the operation injury to the nerve may be serious enough to produce interference with abduction and with adduction (the immediate disturbance of the voice in all but one case bears this out), and that the nerve recovers partially so that the voice becomes normal, but that the portion of the nerve which has to do with breathing does not recover.

The recurrent laryngeal nerve is a pure motor nerve coming from the vagus. It is small but in spite of this can be separated into two distinct bundles of fibres (Russell). One of these bundles supplies the muscles of adduction and the other the muscles of abduction. These fibres run in separate bundles throughout the whole course of the recurrent nerve; those for abduction are on the inner side of the nerve trunk, and those for the adduction on the outer side. They may be dissected to such an extent that one set of fibres responds to electric irritation exclusively by adduction of the vocal cords and the other by abduction. Rosenbach was the first to proclaim that the abductors suffer first from compression of the recurrent nerve. Semon proved, however, that the important pathologic condition is seen not only in local lesions along the cords but also in central cerebral diseases as well as in spinal diseases of an organic nature. Grabower found that the posticus muscle has on the average 281 terminal nerve fibres and the adductors have 680, and he believes that this may explain why the abductor muscles are the first to be affected. If it could be explained how the scar tissue affects both nerves in exactly the same way, the contraction of this tissue on the recurrent laryngeal nerve might explain the condition, especially in view of the fact that the onset is gradual. If it is due to the contraction of scar tissue it is difficult to explain why it is not much more often seen. We have been unable to simulate the condition experimentally. It is entirely possible that it is the result of some toxic influence on the nerve, and yet it is hard to explain why such a small percentage of cases are influenced by it. In the few cases we have seen it has usually occurred in patients with non-toxic goitre, so that the toxæmia of hyperthyroidism could hardly be responsible.

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Discussion.—Although cases of bilateral abductor paralysis following thyroidectomy are extremely rare, they are so serious that they deserve a great deal of consideration. We have observed that the condition progresses until there is considerable difficulty in breathing, especially on exertion, and from then changes are slow. In none of our patients has phonation been affected except from dyspnoea; after a long time the tendency seems to be toward improvement.

Tracheotomy may be necessary because of the small margin of safety, although so far as we have been able to determine there is no danger of acute suffocation. The cords are held in adduction by the contraction of the adductor muscles, and it is probable that these muscles would relax enough to allow the entrance of air in case of any suboxidation.

For the treatment of these cases other than tracheotomy we have considered the advisability of dissecting the recurrent laryngeal nerves from the scar tissue, in the hope that by freeing them the pressure of the contracting scar might be relieved and enable the nerve to functionate normally. We have also considered performing a plastic operation on one vocal cord in order to give more breathing space, but we have hesitated to do this because of the fear of interfering with the voice. Usually when this is explained to the patient he prefers not to take any chance on having phonation disturbed.

It may be said in conclusion that (1) the functional results following thyroidectomy both as concerns phonation and respiration are extremely good; (2) the disturbance which sometimes follows immediately after the operation is temporary, and normal function will be restored in from a few days to a few weeks; and (3) there is a very small group of patients who, following thyroidectomy, have a bilateral abductor disturbance which is slow in onset but is very persistent. We have been unable to work out the cause of this condition, but believe that it may be due to the contraction of a scar, to a peculiar type of trauma to the nerve, or to some form of toxæmia.

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GASTRIC AND DUODENAL ULCERS*

BY CHARLES H. MAYO, M.D.

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THE accident of peptic ulcer, for such I believe it to be, is rare; it represents but a fraction of 1 per cent. of the findings of general necropsies. In the aggregate, however, the condition occurs in thousands of persons, many of whom apparently never suffer from symptoms of gastric trouble; others do not appreciate the symptoms. Undoubtedly some persons have hyposensitive abdomens and experience little reaction from acute or chronic disease; conversely, persons with little pathologic foundation have grave symptoms. In the former the presence of ulcer might first be surmised by hemorrhage, perforation, or obstruction. The majority of persons who have ulcer of the stomach or of the duodenum have well-marked symptoms, almost sufficient from which to make a diagnosis without the corroborative evidence of the röntgenographic or fluoroscopic examination. Peptic ulcer occurs in all climates, apparently with all types of food, and in all races; seasons, spring and fall, increase the symptoms to some extent. During the period when acute and chronic bleeding and perforation and mechanical obstruction were the main diagnostic points of ulcer, bleeding was much relied on in making a diagnosis. These symptoms lost their importance as diagnostic ability improved, and so many cases of ulcer were added to the list that the incidence of hemorrhage was reduced to approximately 20 per cent. in the cases diagnosed.

Peptic ulcer is more common in males than in females, the proportion being three to one. The proportion of gastric to duodenal ulcer is approximately one to four, as shown by reports from the Clinic, where from January 1, 1906, to January 1, 1920, operations were performed on 1191 patients with gastric ulcer and on 4532 patients with duodenal ulcer. A very small percentage of patients have ulcers in the stomach and in the duodenum; in only 203 instances during the fourteen years were both gastric and duodenal ulcer found in the same patient. In a series of 638 patients with gastric ulcer observed in a five-year period, twenty-eight had multiple ulcers; Sir Berkeley Moynihan has called attention to the occurrence of this condition.

As to the etiology: I believe that peptic ulcer is undoubtedly developed by a combination of local chemical effects, possibly causing prolonged vessel spasm or claudication, a counterpart of Raynaud's disease or scleroderma, or by direct interference with the circulation through infarction emboli of bacteria, chemically and mechanically active in the tissues and thereby lowering the local resistance to the action of digestive

* Read before the Southern Surgical Association, December, 1920.

fluids. The two, a changed circulation and peptic action, are most surely associated early. In the diseased tissue, during the periods of varying activity and remissions of chronic ulcer, bacteria can be cultivated from excised ulcer tissue which has been made wholly free from surface contamination. If the cultures grown in such experiments are injected into animals similar ulcers are produced in a high percentage of cases. Rosenow has shown the bacteria cultivated from the tissue of an excised ulcer of the stomach to be the same as those cultivated from the abscess around the root of a tooth. The cultures from each repeatedly injected intravenously produced ulcer of the stomach. A like condition was produced experimentally by cultures from a blind abscess pocket in a small uninflamed tonsil in one other case. In the chemistry of the bacterial products, I believe, lies the explanation of the chronicity of the disease. That ulcer is not produced by traumatism is the testimony of surgeons who operate on persons who have accidentally swallowed sharp or hard substances, and on the insane who have swallowed their table cutlery, nails, hairpins, and similar undigestible material. Ulcer is rarely produced by direct external traumatism; if it were, the greatest difficulty would be experienced in healing incisions for gastrotomy or gastroenterostomy, as in securely adjusting the approximation against leakage and hemorrhage devitalization by suture of the incised area is an essential in the operation.

Practically all ulcers of the duodenum occur in the first portion between the entrance of the common duct and the pylorus, which should be called the antrum or vestibule of the intestine. In this space the acid chyme which is still active with pepsin is held until it is neutralized in the area of Brunner's glands by a secretion apparently called forth by the presence of food in the stomach and not by the acid, although the action is evidently neutralization and preparation for alkaline digestion. The loss of harmony of action in the neutralization process may be an added factor in some cases in the occurrence of ulcer and recurrence of ulcer symptoms. Cannon showed the closure of the pyloric ring to be due to acids. When the acids in a bolus are neutralized the muscle relaxes and the next bolus escapes from the stomach; the gastric peristaltic waves are ineffectual until neutralization is complete. If this observation were not correct, peptic ulcer could occur in diminishing numbers down the upper intestine, since the neutralization of the acid chyme could be accomplished and intestinal digestion continued by an extravagant waste of the digestive alkalies of the upper intestine and glands. Ulcers occasionally appear in the new opening. With cholecystogastrostomy an open pylorus is maintained by the alkaline bile, although nothing leaves the stomach without peristaltic action. The same condition is present in achlorhydria. External pressure on the stomach is seen easily to force the barium into the intestine.

Reeves and others have shown that the anatomic arrangements of the

arteries along the lesser curvature of the stomach, in which parallel arterioles supplied at both ends by arterial majors give an opportunity for some stasis, and a triangular supply throughout the first two inches of the duodenum predispose to thrombosis. Should certain bacteria be present in the blood supply they may as emboli destroy a local area of circulation. Tissue infiltrated with bacteria by chemical action may prevent healing. The relationship of pepsin and acid has always been recognized as associated with the development of these so-called peptic ulcers. The surface ulcers on the mucous membrane may be produced experimentally in numbers by certain toxic materials, other than bacterial, injected into the circulation or administered by mouth, but such ulcers are fleeting; they are not considered in this discussion.

Doctor Sippy, of Chicago, one of America's greatest internists, should be credited with having done the most to coördinate medical thought with regard to the condition of gastric ulcer and its medical treatment, which is based on changing the environment of the ulcer area by controlling the corrosion of gastric acids during exacerbations. He has shown that the combined acids have little to do with activating pepsin during the period ordinarily given for digestion, and that free acid is the activating agent. The medical treatment of gastric ulcer in an exacerbation during waking hours is directed toward controlling and lowering this acidity by dilution or neutralization of gastric contents at regular periods. The food, such as milk and cream, which is permitted during one period has a fairly high percentage of fat which delays digestion; the next period is given to alkalies. This procedure is carried on while the patient is awake and in bed, while the symptoms are acute. Patients are under surveillance for a long period, with repeated tests of the stomach's content and a regulated diet. Such treatment, although effective at least in affording relief, can seldom be obtained by the majority of those afflicted; the patients may be too poor, or for other reasons so situated that they cannot secure the treatment. Because of the years of disability patients with recurring attacks who are cared for in hospitals and out represent a fairly high percentage of gastric ulcers as compared with other diseases. Freedom from symptoms following an attack does not necessarily mean a healed ulcer; however, it must be said that some patients are relieved medically to their satisfaction. While patients are being cared for during many years of recurring attacks some develop conditions, such as hemorrhage, obstruction, and perforation which demand immediate surgery, and not a few develop cancer or ulcer, of which approximately 25 per cent. remain confined to the stomach (a local disease) until death occurs. Ulcer of the duodenum, however, rarely develops into malignancy.

Judging from the literature on this subject, presented by the internist and by the surgeon, there would seem to be a wide divergence of opinion with regard to the condition and its results. Personal conversation with some authors, however, shows that considering their viewpoint, it is not

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so dissimilar as appears from the emphasis placed on certain conditions and symptoms. The internist, in urging medical care, refers to the danger of surgery. In the 4532 cases of duodenal ulcer the operative mortality was but 1.76 per cent.; death naturally occurred in the more severe long-neglected and complicated cases of obstruction, perforation, or hemorrhage, while in the 1191 cases of gastric ulcer the mortality was 3.77 per cent.; but all physicians admit the greater seriousness of the latter condition. Again, the internist refers to the rare bad results, largely avoidable, such as the vicious circle and gastrojejunal ulcer. It is true that some surgeons perform gastroenterostomies because of symptoms, for example, digestive reflexes, abdominal and even spinal, without positively determining the presence of the ulcer. In a number of cases, to the discredit of surgery, it is necessary to cut off and close the gastroenterostomy which was made, although no ulcer was present, the patient being far worse than before the operation. In this manner we have dealt with a few hundred cases in which the gastroenterostomies had been made, based on symptoms alone, since the presence of the ulcer had not been proved. Fourteen of this group of patients had been operated on in our own Clinic in the early developmental period of gastric surgery when abdominal examinations were less thorough, on the surmise that they were suffering from ulcer on the posterior wall of the stomach. The surgeon, on the other hand, appears to discredit the internist, as he never sees an ulcer in the early stage unless it has perforated or is causing hemorrhage; he thus may exaggerate the danger of ulcer. All except emergency patients are treated by many physicians for long periods before they receive the benefits of surgery, and again the surgeons frequently find that they are giving surgical intervention not for ulcer, but for secondary conditions with varying symptoms of gastric disturbance which are not caused by ulcer, but are the response of the stomach in pyloric spasm induced by disease of the appendix, more commonly disease of the gall-bladder, or more rarely disease of the pancreas. Although the patients may have passed years in the active care and treatment of their stomachs, the gastric trouble is reflex in origin. Nevertheless, the patients need surgical treatment.

In the diagnosis of gastric and duodenal ulcers much attention is paid to the history given by the patient of attacks with intervals of health. The relief obtained by taking food, fluid, or alkali and the relationship in time of appearance of symptoms to the last meal are of importance. Qualitative food dyspepsia rarely is associated with ulcer, but represents a gastric reflex appearing within a half hour after food is taken, while quantitative food dyspepsia is usually associated with interference of peristalsis which, if intestinal, appears at the end of one hour. Surgery is usually indicated for relief, but not necessarily surgery of the stomach, for hemorrhage (vomited and by bowel) may come from gastric erosion, from the liver, the pancreas, or from rupture of veins within the stomach

caused by splenic disease. In about one-fifth of the cases of true ulcer hemorrhage is a symptom, but little attention is paid to occult blood except in unusual conditions. It is of interest, however, that in a large series of our early cases of gastric ulcer about one patient in four had had hemorrhage before operation and one in twelve suffered from hemorrhage afterward. This is an additional reason for destroying the ulcer which we strongly recommend as well as making the gastroenterostomy, since if destruction of the ulcer alone is sufficient to cure, natural perforation and its healing should theoretically cure. Perforation, while not common, does occur, without relieving symptoms, however, and unless it occurs as a primary symptom it is not so serious as is generally believed, since nature usually affords protection by immediate stasis and adhesions.

Great reliance is placed in the X-ray to corroborate the clinical history and general diagnosis of the condition. Carman and his co-workers in the Clinic who have wide experience in such cases are able to make the diagnosis from the X-ray standpoint in 95 per cent. The importance of the X-ray is very great in determining whether the ulcer is gastric or duodenal, which is often difficult or impossible clinically.

We agree with Sippy that control of the acids limits peptic activity and gives relief of symptoms, but we also agree with Moynihan that treatment but tides the patient through the exacerbation and does not cure permanently. One or two years between attacks without treatment is a common early history. A gastroenterostomy, however, permanently applies the medical principle of treatment by overcoming the effects of pyloric spasm, preventing retention of gastric secretion after food has left the stomach, and by allowing sufficient quantities of the alkaline secretion of the duodenum to pass into the stomach to lower the general acids. This fact was first called to our attention by Paterson. Lemon, in a series of 200 cases in our Clinic, showed the reduction in general acids after operation to be 39 per cent., and in free hydrochloric acid 46 per cent. The change in the local environment apparently often permits nature to heal the ulcer as well as to overcome symptoms. The retention of a considerable amount of secreted acids in a stomach free of food indicates a pyloric spasm and a varying loss of balance between the neutralizing alkalies in the first portion of the duodenum and the acids of the stomach, and herein lies the defect of pyloric operation for ulcer, effective as it may be for spasm; for a time it relieves by removing the control of the gastric outlet, but the acidity is not changed. A high proportion of combined acids as compared with the amount of free acid indicates delay or retention caused by spasm or obstruction. In gastric ulcer the marked lowering or loss of free acid and increase of combined acids may indicate malignant change, although it is admitted that cancer of the stomach occasionally occurs with a high acidity. The same change in acids, lowering of free acid and increase of combined acids, is often found associated

with pyloric spasm secondary to cholecystitis and pancreatitis. Achlorhydria is seldom changed by medication or surgical intervention; certainly gastroenterostomy is not indicated. Do all cases of ulcer require operation? In some instances in a routine general examination ulcer of the duodenum is found without appreciable symptoms. Frequently we do not operate in such cases, but we inform the patient of his condition, direct him to live with greater care, and advise him that operation will be necessary if certain symptoms arise, or if the routine of life is deranged by such special care. In the earlier stages of duodenal ulcer destruction by cautery and closure is effective at least for a time. A number of such cases have been observed in the Clinic. In ulcer of the stomach with low acidity this procedure may be successful, but with high acidity and greater spasm gastroenterostomy is indicated even after excision or destruction of the ulcer. I believe that the excision or destruction of ulcer of the stomach, even if it gives but few symptoms, is indicated regardless of the degree of acidity. Should gastroenterostomy always be made after destruction or removal of ulcer of the stomach? In some cases, in which the symptoms are only occasional and of short duration with long intervals of health, the closure of an acute perforation is all that is required, as in them the acids are low.

In a study of the results of 647 operations performed in the Clinic on 638 patients with calloused ulcer of the stomach from July 1, 1914, to July 1, 1919, the average mortality was 3.2 per cent., more than double the average mortality in 2734 operations performed in the same period on 2720 patients with duodenal ulcer. Five hundred and thirty-four ulcers were located on or around the lesser curvature, eighty-five on the posterior wall, nine on the greater curvature, and five on the anterior wall; the location of five was not definitely recorded. Of those on the posterior wall 8.2 per cent. were in the pyloric third, 73.3 per cent. in the middle third, and 16.5 per cent. in the cardiac end. All were of the chronic perforating variety and fifty-three were attached to the pancreas and involved it in the ulcerative process. Fifty-seven of the eighty-five patients were males and twenty-eight were females; their ages varied from eighteen to sixty-nine; the average was about forty-four; the average duration of symptoms was six and one-half years.¹⁰ Investigations for many years at the Clinic have led us to reiterate the assertion that gastric ulcer is potentially malignant, although by a post-mortem examination of extensive disease causing death it may be impossible to determine that an early ulcer was present. Many ulcers that we believed to be benign and excised showed the presence of carcinoma in a limited area of the margin. We believe that Aschoff is correct in his assertion that if the lesion is cancer originally the base of the ulcer will prove to be cancer, but in a few cases the cancerous area was in the margin only, and we therefore believe cancer often develops on ulcer, and hyposensitive stomachs obscure early symptoms.¹⁴

Balfour, on the theory that malignant cells are much more vulnerable to heat than normal cells, suggested and developed a slow destruction of ulcer by perforation with the cautery and immediate closure and gastroenterostomy (Fig. 1).

In the removal of perforating ulcers of the posterior wall of the stomach attached to the pancreas we use the upper approach through the gastrophrenic omentum. The finger is hooked around the attached ulcer area and the ulcer shaved from the pancreas, its margins are cut away with a knife or cautery, and the opening closed with chromic catgut sutures. To protect and mobilize this area of the stomach a gastrocolic omental opening is made between the stomach and the colon, and the margin of the omentum is drawn through the opening and plastered over the posterior wall of the stomach, to which it is fixed by sutures, covering the area from which the ulcer was excised, as well as the pancreas. A posterior gastroenterostomy is also made (W. J. Mayo).

In eighty-nine operations performed in the Clinic for hour-glass stomach the operative mortality was 7.4 per cent. Of the various methods of excision and plastic enlargement of the stomach for the relief of this most distressing condition the sleeve resection of the central portion of the stomach, usually with gastroenterostomy, is performed. If there is a recurrence we remove the lower half at the second operation, uniting the narrowed proximal portion to the jejunum, and sometimes to the duodenum. As a rule, we also make the same type of union of the stomach with the duodenal end or the jejunum for extensive ulceration and thickening, and for local cancer in the pyloric region after resection of the stomach. I first saw the end-to-side union of the stomach and the jejunum in 1912 in Germany and in Austria, where it was called by some the Hofmeister operation, and by others the Enderlin. Later we found it had been described by Polya in 1911. I performed five of the operations in 1913. After division of the stomach the proximal end was drawn through an opening in the mesentery of the transverse colon, to which it was sutured and the jejunum applied to the whole of the cut area of the stomach, a large opening being made and the duodenal division being closed by suture. In some cases this operation gave trouble from traction of the transverse colon on the stomach and, when the operation was performed for cancer, the rich blood supply of the mesentery, if recurrence occurred, caused early obstruction. Balfour obtained a higher percentage of good results by making the same attachment of the jejunum anterior to the colon, and we have adopted this method and found it very satisfactory. In large openings in the end of the stomach I have found additional advantage in partial closure and covering the closed portion with the unopened jejunum by suture. By turning the jejunum to the right a loop of from 12 to 14 inches is sufficient to provide for the drop of the colon; the jejunum, passing around to the left of the sagging transverse colon and coming out of its splenic flexure, receives no pres-

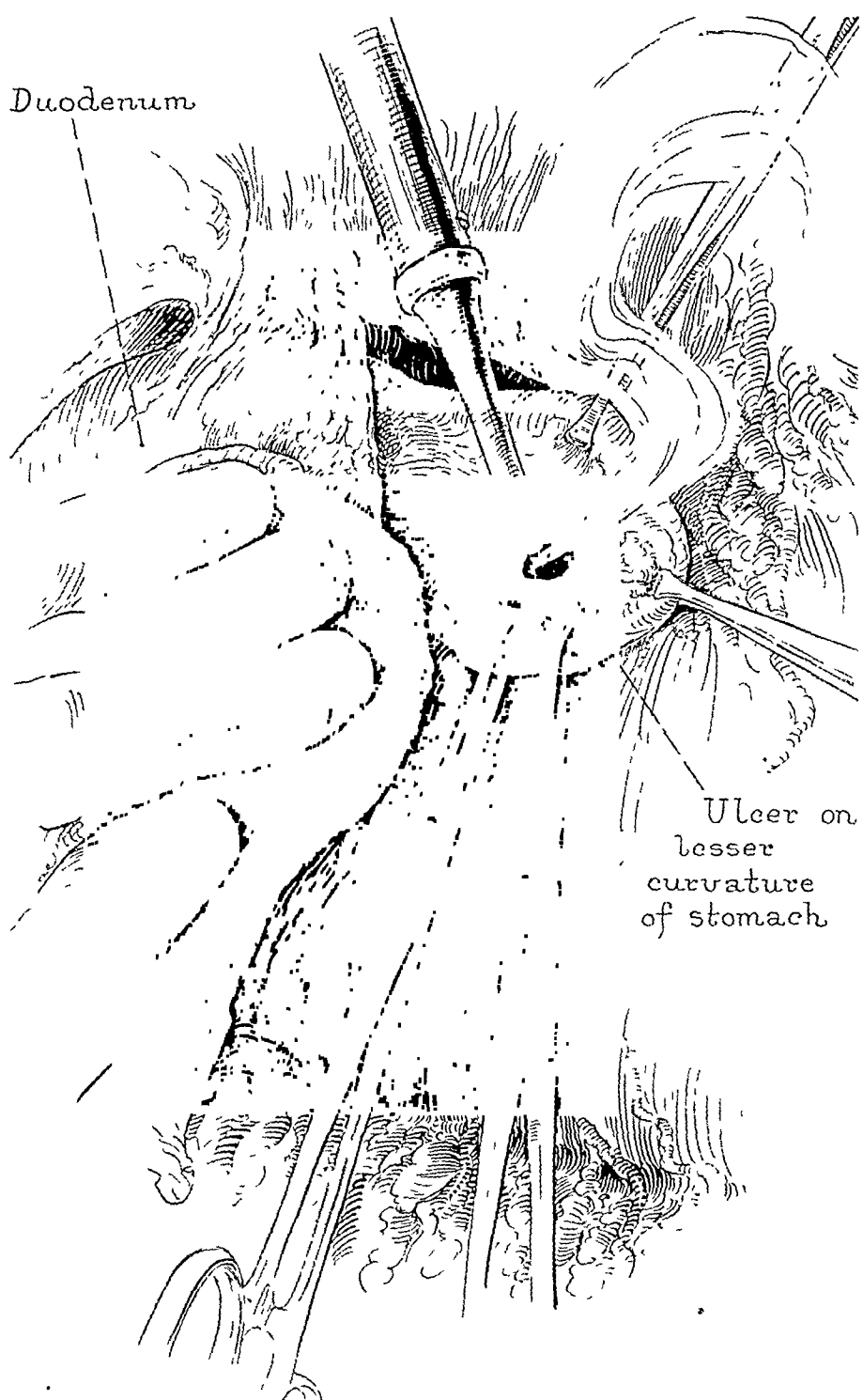


FIG. 1.—Destruction by cautery (Balfour method) of ulcer on the lesser curvature the stomach.

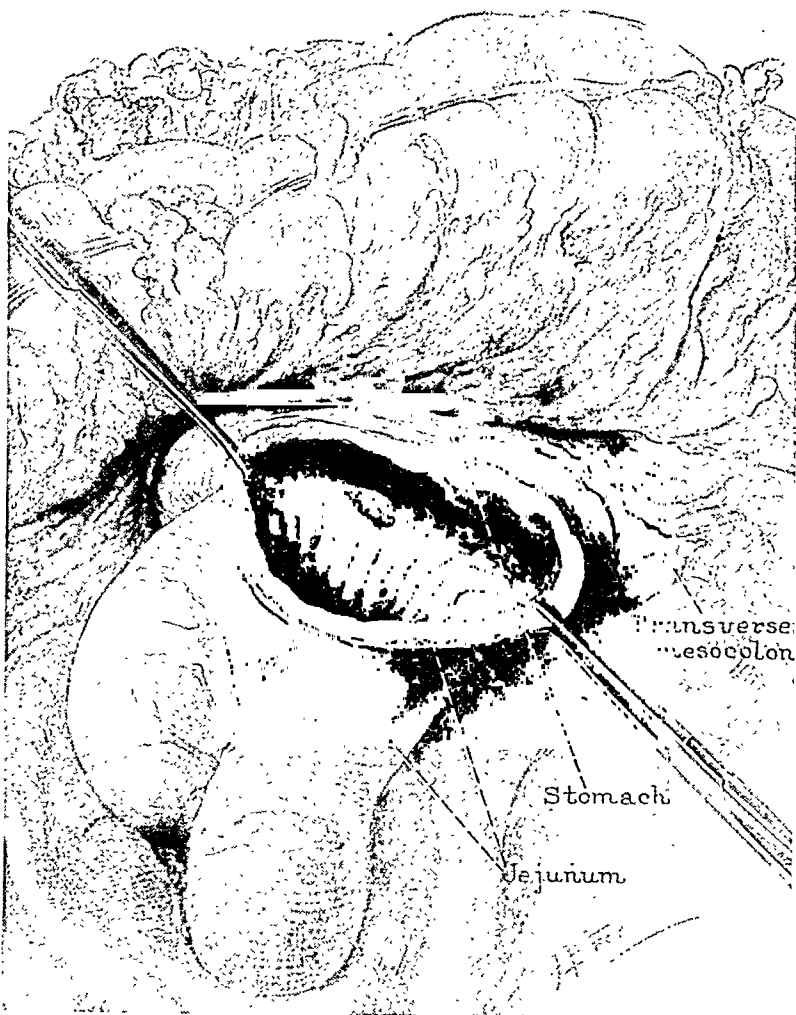


FIG. 2.—Gastrojejunal ulcer on the suture line at the site of an old gastroenterostomy.

sure from the colon: isoperistaltic attachment. The surgeon must watch that the first loop or coil of jejunum is not left turned under the attached second loop to cause obstruction. Surgeons who do not turn the bowel also have good results.

Gastrojejunal ulcer is an unfortunate condition which occurs in a small percentage of patients who have been primarily relieved by gastroenterostomy, but their troubles are so continuous or the recurrence of spells so frequent after some months of apparent cure, and they consult so many physicians, that each case apparently stands for a multitude of failures. Such cases do much to discredit the surgical treatment of ulcer, since contraction closes the gastroenterostomy ultimately and possibly the bowel; and many physicians still believe natural closure to be the ultimate fate of gastroenterostomies, although in truth it is a rare condition. But even the present small percentage of gastrojejunal ulcers can be markedly reduced, I believe, by avoiding the use of permanent suture material for the brief period demanded in the ordinary case of gastroenterostomy; undoubtedly it can be lowered still further if more attention is paid to freeing patients of their foci of chronic infection, usually streptococcic, which give the opportunity for new infarctions at the point of gastrojejunal union, often commencing before healing is completed. We admit that silk sutures hang for long periods in the majority of cases without causing ulcer (Fig. 2).

To January 1, 1920, we had operated on eighty-three patients with gastrojejunal ulcer, of which forty-seven followed gastroenterostomies performed in the Clinic for benign duodenal or gastric ulcer, and thirty-six followed primary operations elsewhere.⁶ In a number of this group the permanent silk suture was found hanging in the ulcer's indurated area, and in others it had apparently but recently passed out; in four instances the sutures have been found hanging from the ulcer area and exposed to the gastric fluids four years following the operation, and in a larger number of cases the same condition has been found after shorter periods following operation. In such cases the patient complains much as before the operation, and the trouble is more continuous.

The röntgenogram gives valuable aid in the diagnosis of gastrojejunal ulcer in about 80 per cent. of cases. In three instances we have seen such ulceration perforate the colon and produce a gastrojejunal colic fistula. If the ulcer area is small its excision is advisable; and the opening should be reestablished by catgut suture. In extensive areas of ulceration and partial closure the gastroenterostomy is undone, and the bowel and the stomach closed; in a few cases it has been found advisable to enlarge the pyloric outlet by some of the plastic methods.

Gastric ulcers should receive special consideration because of the seriousness of perforation, the chronic symptoms, the frequent deformity and fixation of the stomach, the not infrequent development of carcinoma, and because the results following gastroenterostomy for gastric ulcer are

certainly not so good as those following gastroenterostomy for duodenal ulcer. Graham, in an investigation of 438 cases of duodenal ulcer, found that 70 per cent. of the patients who survived operation considered themselves well following gastroenterostomy, 27 per cent. were improved, and 3 per cent. unimproved.

The future condition and length of life of patients with peptic ulcer are problems recognized by insurance companies in considering the applications for insurance of those who have had operations for ulcer. Hunter, Actuary of the New York Life Insurance Company, in an investigation at the Clinic of the results of operation in a large series of cases of gastric and duodenal ulcers, found that the average death-rate for the four-year period after operation in patients with gastric ulcers was slightly more than three times the normal, while in patients with duodenal ulcers it was if anything slightly less than normal. The series consisted of 2431 patients, and all but 108 were traced.

CONCLUSIONS

If it is true that there is an average duration of a number of years in the majority of cases of duodenal and gastric ulcers, many extending from twenty to thirty years, it is probable that there is an exaggerated idea of their danger to life. Acute perforation is a serious danger, which is greater when it occurs as a primary symptom of ulcer. Subacute and chronic perforations are frequently noted at operation. Extensive hemorrhage may also cause death. While few persons die from these conditions the number is greater than the number of those who succumb from surgical measures, which, if instituted in time, should restore the patient to health and activity. It is true that patients suffer, are disabled and should be relieved, and it is also probable that but a small percentage of the total number of ulcers are early recognized and treated for the true condition. Gastric ulcers may give greater discomfort than duodenal ulcers, and because of the danger of malignant degeneration should be destroyed at the time of the operation unless this procedure would add unwarranted immediate risk. I believe patients who have gastric ulcer should be informed of this danger. While blocking the pylorus has been recommended in addition to gastroenterostomy and practiced, the procedure was unnecessary and is now obsolete. In the surgical treatment of ulcer we have applied a well-known principle of agriculture: an acid and continuously wet soil is tile-drained and its surface limed.

In fact, the surgical treatment of ulcer is the best recognition of the value of medical treatment in permanently overcoming delay or obstruction and lowering the acidity with the patient's own alkalies.

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SUBPHRENIC PYOPNEUMOTHORAX—SUBPHRENIC ABSCESS*

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A SUBPHRENIC abscess is a comparatively rare condition; a subdiaphragmatic pyopneumothorax is still more unusual. The term subphrenic abscess is applied to any collection of pus situated immediately below and in contact with the diaphragm. As the liver occupies most of the space immediately below the diaphragm these abscesses are located usually between the upper convex surface of the liver and the under surface of the diaphragm. The falciform ligament divides the subphrenic space into two compartments, and forms a barrier to the spread of infection from one side to the other. The coronary ligament and its extension into the right and left lateral ligaments, forms a partition between the anterior and posterior surfaces of the liver. Collections of pus may therefore occur in five areas: (1) Right anterior; (2) left anterior; (3) right posterior; (4) left posterior, and (5) between the folds of the coronary ligament. Abscesses in all of these areas are intraperitoneal with the exception of the fifth, which is extraperitoneal. The causes of subphrenic abscess are numerous. The most frequent cause is probably appendicitis, the infection extending, usually by direct continuity of tissue, to the posterior right lateral aspect of the subdiaphragmatic space. Of almost, or quite, equal frequency are abscesses due to perforating ulcers of the stomach and duodenum, those on the lesser curvature of the stomach usually causing abscesses to the left of the falciform ligament, while perforations of the duodenum cause abscesses to the right of this fold. Other causative agencies are cholecystitis, cholangitis, abscess of the liver, diseased conditions of the colon, spleen, kidneys and pancreas, residual abscess from peritonitis, external injury, disease of the ribs or spine, empyema and pneumonia.

The abscesses sometimes contain gas, in varying amounts, which may have gained entrance from a perforated hollow viscus or may have developed from the action of gas-forming organisms.

The symptoms of subphrenic abscess are frequently obscure and the condition is, doubtless, often overlooked. The symptoms will vary somewhat with the cause and the seat of the disease. Chills, fever, and sweating are often present, while pain and tenderness with hardness and rigidity of the affected region sometimes can be elicited. At times the area of liver dulness may be increased, or it may be partially or entirely lost. An increased leucocytosis generally will be found. An X-ray

* Read before the Southern Surgical Association, December 16, 1920.

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examination should always be made, but the findings may not be conclusive or may be misinterpreted.

The treatment is incision and drainage, and this frequently involves a transpleural thoracotomy.

The object of this paper, however, is not to give an exhaustive description of this condition, but to report two cases that have occurred in my service during the current year, which presented somewhat unusual features.

CASE I. *Pyopneumothorax Subphrenicus*.—W. G., aged sixty-five years, was admitted to University Hospital on February 12, 1920. For three years he has had stomach trouble, consisting of attacks of pain and acidity, which were generally relieved by eating, or by taking bicarbonate of soda. At times he would have to take food in the middle of the night to relieve his distress.

These attacks have become more frequent, and during the past year vomiting has supervened. No blood, however, has ever been noticed in the vomitus. About ten days ago he was taken with more severe symptoms and the pains became spasmodic in character.

On admission his temperature was $101\frac{2}{5}^{\circ}$; pulse, 108; and respiration, 28. The heart sounds were clear and normal. The lungs were somewhat emphysematous. On inspection the abdomen was seen to be distended in the upper zone, below the umbilicus it was rather flat. There was rigidity and tenderness in the right upper quadrant and in the epigastrium. The liver dulness was entirely absent. The pains continued and became more severe and vomiting occurred more frequently. An analysis of his stomach contents showed free HCl, 36 per cent.; total acidity, 48 per cent.; and several analyses subsequently showed an even greater acidity. The blood-count showed red-cells, 4,900,000; leucocytes, 5600; polynuclears, 69; small lymphocytes, 30; eosinophiles, 1; hæmoglobin, 85 per cent. Urea in the blood was .3 grain per 1000 c.c. The Wassermann reaction was negative. The urine contained albumin and an occasional cast, but no sugar; specific gravity, 1017.

Clinical Impression.—Gastric or duodenal ulcer, probably perforated and walled off.

Skiagraphic Report.—Small heart, displaced to left. Dome-like shadow in middle portion of right chest, arching from the mediastinum on a level with the eighth rib posteriorly upwards to middle portion of chest, then downwards to the axillary region. This shadow is about one-half cm. in thickness and corresponds in outline with the diaphragm, but it is about three inches higher than the normal position of the diaphragm. Below this shadow there is an area of increased density homogeneous in appearance, which extends to the tenth rib, and below this homogeneous shadow are areas of lesser density showing the presence of air. The upper border of the diaphragm is irregular in shape and shows the presence of several broad adhesions.

The examination suggests an old empyema with pneumothorax in the lower right chest. Notwithstanding this report, we held to the clinical findings and acted accordingly.

Operation (February 16th).—Under nitrous oxide and ether anaesthesia an incision was made vertically through the right rectus muscle. The liver was found to be adherent around its edges to the abdominal parietes, which when separated allowed a quantity of gas to escape. This gas had a colon bacillus odor. There was but little pus, but the surface of the liver was covered with a grayish exudate. The stomach was also bound down with dense adhesions. After breaking up these adhesions a small perforation was found on the lesser curvature of the stomach, which was closed with two rows of sutures and a posterior gastroenterostomy done. Rubber tube and gauze wick drains were introduced.

Following the operation there was much drainage from the wound, moderate elevation of temperature, and acceleration of the pulse, but no vomiting or pain. He died, however, two days later, with symptoms of general sepsis.

Autopsy Report.—The liver was large and extended three finger breadths below the costal margin in the right clavicular line. All the organs on the upper side of the abdomen were matted together. The diaphragm on the right side extended to the fourth interspace, on the left to the sixth. The upper surface of the right lobe of the liver was covered with a yellowish exudate. The peritoneum was glistening and was not inflamed. An ulcer was found on the lesser curvature of the stomach, which was leaking from a small opening.

The clinical history of this case is typical of gastric or duodenal ulcer and the cutting pains suggested that a perforation had occurred, while the absence of signs of peritonitis showed that the rupture was walled off by adhesions. The chief interest in the case depends upon the complete loss of liver dulness. It is a well-known fact that many subphrenic abscesses contain gas, which may come from a perforated viscus or may be due to microbic action, but in this case the whole liver area was tympanitic on percussion. The rest of the abdomen was not unduly resonant and was collapsed rather than distended. When the abdomen was opened no free gas was found in the general peritoneal cavity, but there was a large collection of gas encapsulated between the right lobe of the liver and the diaphragm, which was due to an ulcer on the small curvature of the stomach. This fact is also noteworthy, as perforations on the lesser curvature are said by most authors to cause abscesses to the left of the falciform ligament. The low leucocyte count, 5600, is also striking. Another feature in the case was the misinterpretation of the skiagraphic findings, which suggested to the röntgenologist an encapsulated supraphrenic pneumothorax, the curved dome of the diaphragm being so far displaced upwards that it was thought to be the condensed lower margin of the lung.

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CASE II. *Subphrenic Abscess—Possibly From an Abscess of the Liver.*—M. W., male negro, aged twenty-one years, was admitted to University Hospital June 9, 1920. The present trouble began on June 2, 1920, suddenly, with giddiness and pain in the right side under the ribs. He says he has had no cough or expectoration and that the pain was increased on deep inspiration. He is a healthy-looking person, who has never lived in the tropics or, indeed, out of Maryland.

Physical Examination.—On the right side there is decreased respiratory movement. On this side also both anteriorly and posteriorly the percussion note, from the third rib down, is markedly impaired, becoming dull near the base. The breath sounds are diminished on the right side, becoming lost at the base. There are a few râles at the left apex and the whole left side of the chest is hyper-resonant. At no time has he had chills. On admission his temperature was 102°; pulse, 110; respiration, 28. Under the impression that the case was an empyema an interne aspirated the chest and drew out pus. Having a suspicion that the case might be one of abscess of the liver, I ordered an X-ray examination to be made, which showed a rigid diaphragm with a clear picture above the diaphragm and a cloudy one below, on the right side. The left lung was quite clear. There was absolutely no pneumonia of either lung. The urinary examination showed nothing abnormal. The Wassermann reaction was negative. Cultures from the aspirated pus grew out pneumococci and streptococci. No amoebæ were found in the stools.

Operation (June 24, 1920).—Nitrous oxide gas and ether anaesthesia. An incision was made over the tenth rib in the posterior axillary region, and about two inches of this bone was excised. The pleura presented and a small opening was made into it, which showed it to contain no pus. This opening was then sutured and the pleura was detached from the diaphragm. An opening was then made through the dome of the diaphragm and a large quantity of thick, almost gelatinous, pus escaped. The upper surface of the liver seemed to be rough and pitted. One rubber tube and three pieces of gauze were introduced for drainage. He did well, suffered but little, and was out of bed in a short time. Drainage was quite free and eventually a considerable discharge of bile was established. A microscopic examination of the pus failed to show hooklets, scolices or parasites, nor were any hepatic cells found.

The patient left the hospital with a sinus, but returned to the dispensary for dressings. Early in September the external wound had healed and he went home, some distance in the country. About the middle of the month he was taken ill and died in a few days. His physician thought he had a recurrence of the abscess, but no autopsy was made and the cause of death remains in doubt.

I am inclined to think that the abscess in this case was extraperitoneal; that is, situated between the layers of the coronary ligament, as the collection of pus was far back and no induration could be felt any-

where, nor was there any material pain or discomfort after he came under my observation. Cultures from the pus showed pneumococci and streptococci, while both physical and X-ray examinations showed no evidence of pneumonia whatever.

Whether there was an abscess of the liver is problematical; the chief cause for suspecting that such might have been the case was the rather free discharge of bile subsequently and the fact that my finger detected a pitted and rough spot on the upper surface of the liver.

Lastly, the differential diagnosis between an abscess situated immediately below the dome of the diaphragm and a low encapsulated empyema is attended with many difficulties. Aspiration is useful in showing the presence of pus, but is of doubtful value in determining its exact location. A skiagraphic examination is also of value. If the pus is situated below the diaphragm the dome of this structure will be pushed up and it will be more convex than normal, while the clear lung will show above, if there is no fluid in the pleural cavity. By means of aspiration and the X-ray examination a reasonably accurate diagnosis may be made, but the exact location of the pus may await the surgeon's knife.

THE TECHNIC OF HEPATICODUODENOSTOMY, WITH SOME NOTES ON RECONSTRUCTIVE SURGERY OF THE BILIARY DUCTS

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THE surgery of the gall-bladder and biliary tract has been distinguished by great advances during the past few years. Of the various factors which have contributed to this development the adoption of a routine exploration of the bile-ducts and their environs as a necessary part of every operation on the gall-bladder gave the greatest impetus to progress. Such routine explorations have not only minimized the possibility of overlooking surgical conditions in the biliary tract, but have placed on record information, particularly with regard to the pancreas, which should ultimately be of great value in elucidating some of the perplexing problems still associated with this field of surgery. Experienced surgeons are only too well aware, however, that the most circumspect inspection and palpation of the gall-ducts and pancreas do not always exclude the presence of a well-concealed gall-stone, and are in accord, that, should any doubt remain that the full extent of the pathologic condition has been revealed by such exploration, instrumental exploration of the ducts from within becomes imperative. The freedom and safety with which this procedure is carried out is one of the accomplishments of modern surgery.

In marked contrast to the simplicity with which the common duct can usually be incised and explored are the difficulties which confront the surgeon when plastic or reconstructive surgery of the ducts¹ becomes necessary. The occasions for these much more serious types of operations and the various methods advocated for restoring biliary function have been presented in a number of excellent articles, notably one by Sullivan, on the use of the rubber tube; one by Walton, on his method of using the duodenal flap; and one by Eliot in which a very complete review of the subject is given. The former experiences in the Mayo Clinic were placed on record by W. J. Mayo in 1916.

The more common conditions or circumstances which may give rise to the necessity of reconstructive surgery of the bile passages may be conveniently classified as follows:

1. New growths, malignant or benign, usually occurring as duct cancer or cyst; stricture or rupture of some portion of the tract usually due to the pressure or the passage of a gall-stone.
2. Injuries to the ducts during operation, for example, stricture due to crushing or ligation; division or resection of a portion of the duct.

The number of cases of the first group is relatively few, and the technical points concerned in their management are suggested in the discussion of the second group. The second group is of unusual importance, because such injuries are by no means few⁷; because they occur most frequently during the operation of cholecystectomy, an operation which is widely and rightly recognized and adopted as the one of choice in the varied pathologic conditions in the gall-bladder; and because such injuries are avoidable.

By far the most common cause of such injuries can be attributed to the failure to identify the cystic duct. The identification of this duct in cholecystectomy is not always easy, because of the occasional difficulties in securing good exposure when the depth of the operative field, the slight mobility of a small liver, and acute or chronic inflammatory changes in and around the gall-bladder and ducts combine to embarrass the surgeon in the dissection and isolation of the cystic duct. In such cases the liver should be drawn downward and toward the median line, and separated with a spatula from the abdominal wall. A gauze compress is placed between the superior right lobe of the liver and the chest wall just behind the hepatic duct.⁹ With the liver thus held when the gall-bladder is tracted the region of the hepatic and common duct is well exposed. Occasionally it is advisable to remove the gall-bladder from without inwards, or after emptying it to split it longitudinally down to the opening of the cystic duct. As a rule, however, with the technic described by Judd, the dissection can be begun at the cystic duct with safety and certainty. Our experience in the Mayo Clinic has been that even when acute inflammation and œdema exist, cholecystectomy can be carried out without greater risk and with as good or better immediate results than accompany cholecystostomy, and the patient is spared a later operation, which so frequently is a sequence to cholecystostomy.

The second most common cause for injury arises when active hemorrhage occurs from the cystic artery, or from some anomalous branch of the hepatic artery. Blindly grasping with heavy cutting forceps into the space in which the artery has retracted has not infrequently resulted in a crushed common or hepatic duct with a later permanent stricture or fistula from ligature, scar formation, or necrosis.

The various anatomic anomalies in the biliary tract and in the related blood-vessels, which have been reviewed lately by Eisendrath^{2,3} and Gosset,^{5,6} and others, may finally be mentioned as a contributing cause. When the cystic duct is anomalous in its length, course, or union with the deep duct, the danger of such accidents at the hands of surgeons who are unaware or who are forgetful of the incidence of such anomalies becomes considerable.

The most common of all injuries, division or resection of a portion of the common or hepatic duct, is due, as has been pointed out, to a failure exactly to identify the cystic duct, and this in turn is often due to the

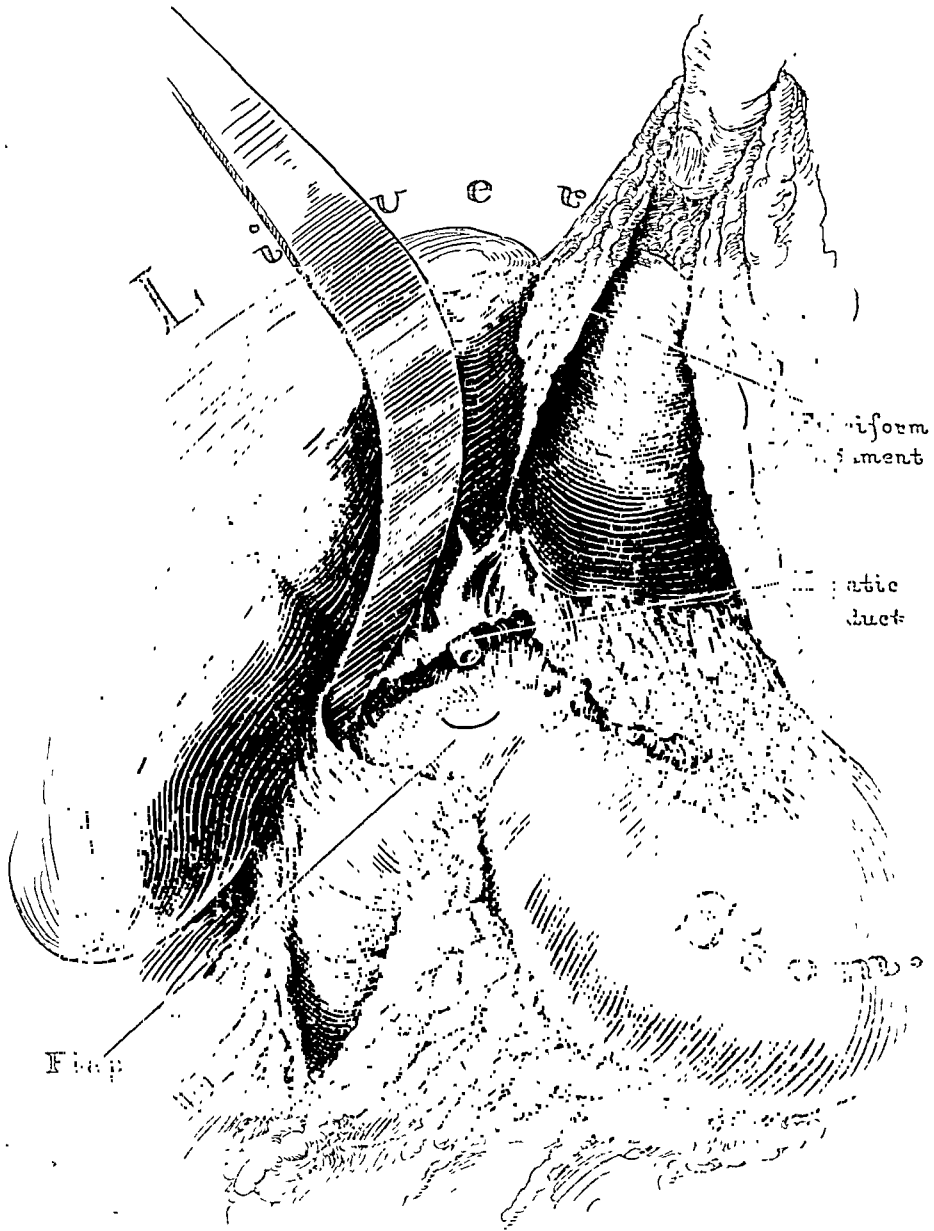


FIG. 1.—Adhesions divided and the cut end of the hepatic duct exposed.

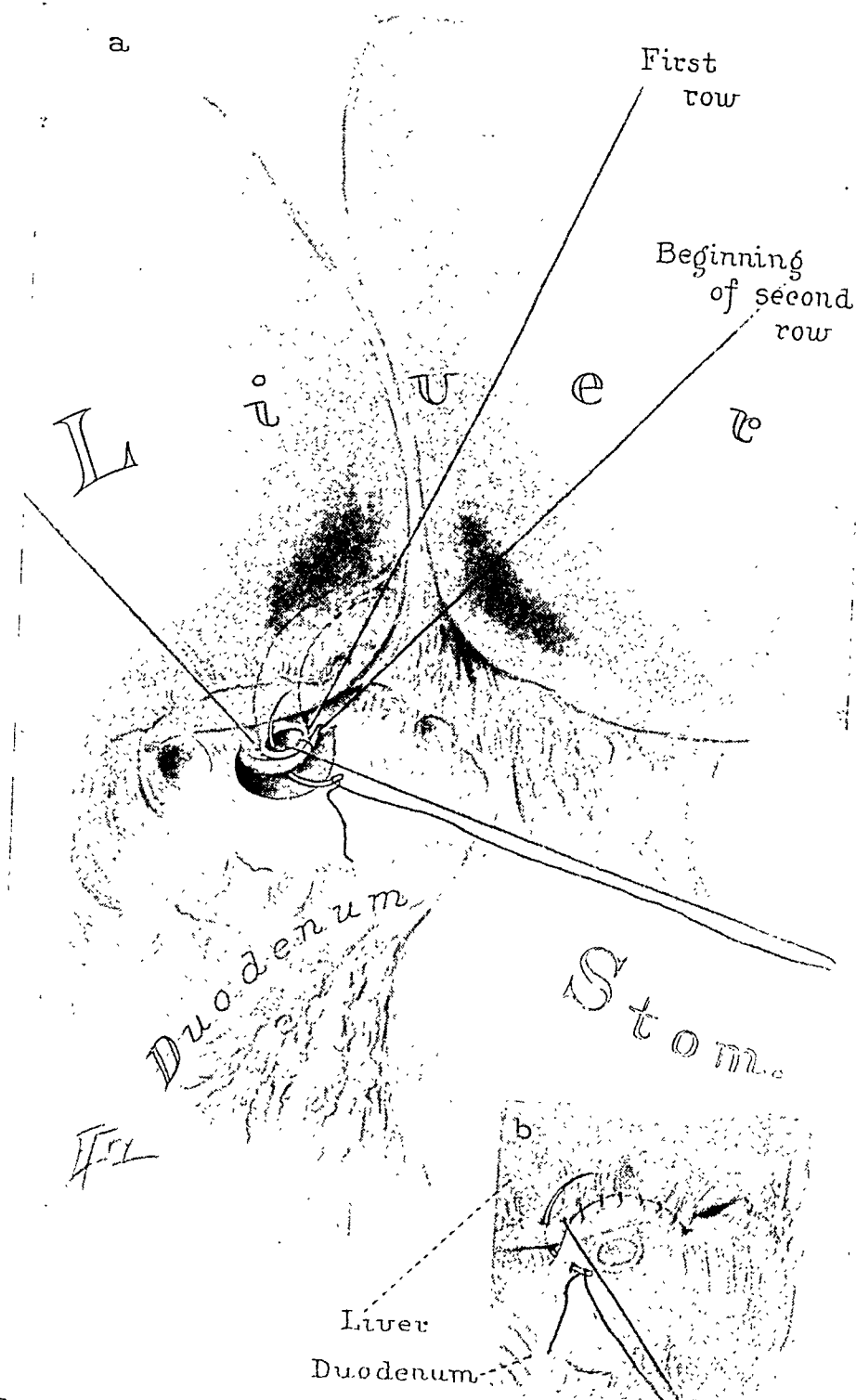


FIG. 2.—(a) All layers of the duodenal flap sutured to the entire thickness of the hepatic duct two-thirds of the way around posteriorly to secure a muco-mucous union posteriorly and laterally. (b) The free anterior margin of the opening of the duodenum is sutured to the surface of the liver above, leaving a large interval between the duodenal mucosa and duct so as to allow for contraction.

anomalies just mentioned. Few surgeons of wide experience have not accidentally committed such an error. I recall very vividly the first time these abnormalities and their dangers were brought to my attention. I was performing a cholecystectomy under the most favorable conditions; in placing a curved clamp on the cystic duct below a small stone impacted in its lower portion, a loop of the hepatic duct about 2 cm. in length was engaged, and resected when the cystic duct was severed. It is generally true, fortunately, that the results of such an accident, if recognized at the time, can be remedied. In this case I employed a T-tube to aid in the anastomosis. Interrupted catgut sutures were first carefully placed in the tissues posterior to the duct to lessen, as much as possible, tension on the suture line in the duct; then the cut ends were sutured posteriorly; the tube was put in position and finally the union completed laterally and anteriorly. The tube was removed in three weeks and a perfect functional result has been maintained for more than five years. The anastomosis can also be made over a small straight tube, or, when the duct is large, without the use of a tube. The point to be emphasized is the importance of realizing that an injury has occurred and of repairing the damage immediately; otherwise the patient is left in a most unfortunate condition, for, if he survives the operation a very serious second operation must be performed, either to relieve duct obstruction due to ligation or stricture, or to close a persistent biliary fistula.

A considerable number of cases has been observed in the Clinic in which the injury was either not recognized or the damage not properly repaired at the time the accident occurred. These cases tax the abilities of the skilled surgeon to the utmost. In some the injury has been such as to permit reconstruction by the method which I just described, or by one of the many ingenious methods which have been described by others. On the other hand, the damage may have been so extensive or of such a character as to necessitate the implantation of the hepatic duct into the duodenum. This operation has given better immediate and late results than other methods employed in the Clinic, and we look on it as the operation of choice in the average case of this type. Even in the most hazardous cases in which jaundice has existed for some time, with the resultant serious changes in the liver, the blood-vessels, and the blood, the permanent reestablishment of biliary function by direct union of the hepatic duct and the duodenum can be accomplished with reasonably low mortality.

The method of hepaticoduodenostomy evolved by W. J. Mayo has certain obvious advantages over previous methods and offers, I believe, the best chance of success, when its details are scrupulously carried out.^{10, 11 *}

* W. J. Mayo reported in 1905 one of the earliest successful cases of hepaticoduodenostomy. The patient fifteen years later is alive and well; she has had several children since, and, although she has gone through severe illnesses, she has never had the slightest obstruction or infection of the liver ducts.

An incision is made in the epigastrium slightly to the right of the midline, beginning at the sternal notch, and continuing downward for a distance sufficient to permit ample exposure. Through the upper end of this incision, avoiding in this way the adhesions in the former field of operation, an attempt is made to dissect directly down on the common duct (or its site, if it has been resected). The duodenum should first be located and is usually found in the mass of adhesions which have developed around the stump of the hepatic duct. Fortunately it is not necessary to locate the distal end of the common duct. The stump of the hepatic duct may be exceedingly difficult to find, especially if no fistula exists, and in debilitated patients many anxious moments may be spent in searching for it. The most careful dissection is necessary in those cases in which a piece of the common duct has been removed, because of the tendency of the portal vein to bulge into the space formerly occupied by the duct. Before any doubtful channel is opened the use of a fine aspirating needle with a glass-barrel syringe is, of course, advisable. Experience has shown that the stump of the hepatic duct lies, as a rule, flush with the liver, and that if dissection is carried down the liver notch from which the gall-bladder has been removed, a mass of fixed tissue, containing the remnants of the right free margin of the gastrohepatic omentum, will be found, which, when dissected from the liver, will disclose the duct. The stump of the hepatic duct is freed as much as possible from its adhesions, but it is rarely possible to secure a projection beyond the liver fissure for more than 0.3 cm. to 0.5 cm. The duodenum, as has been noted, is usually drawn into the same mass of adhesions and it is always wise to avoid separating it posteriorly. If it is separated, a few catgut stitches will draw it up again to the stump of the duct. A slightly curved flap is then dissected out of the entire thickness of the duodenal wall over an area which will leave an opening into the duodenum about 2 cm. in diameter (Fig. 1). The duodenal flap is then approximated to the posterior and lateral aspects of the stump of the hepatic duct in such a manner as to permit of a mucomucous union of the posterior half of the circumference of the duct, with the edge of the flap sutured as shown in Fig. 2. The opening in the duodenum is, of course, much larger than the hepatic duct. The remaining free margins of the opening in the duodenum are sutured to the capsule of the liver just above the hepatic duct end by continuous catgut suture so that the under surface of the right lobe of the liver, or more correctly Glisson's capsule and the scar tissue adherent to it, effectually closes the opening in the duodenum not occupied by the end of the hepatic duct. A considerably wider area of the duodenum is then drawn up toward the liver and fixed with catgut sutures. The omentum is caught by the tip and divided if necessary so that it may be used effectually to surround the anastomosed area. Drainage is seldom necessary; if needed two small strips of rubber tissue are introduced, one above and one below the anastomosis. In some cases

THE TECHNIC OF HEPATICODUODENOSTOMY

a moderate amount of bile may escape for a few days. This has always ceased within a week, however, and healing finally has been complete in each case. In no case has there been any evidence of subsequent obstruction to the duodenum, and in no case a failure to deliver bile into the duodenum.

It will be noted that this technic provides a large opening in the duodenum and a mucomucous union for two-thirds or at least one-half the circumference of the hepatic duct stump. These provisions, together with the method of suturing the opening in the duodenum to the liver, allow for contraction and obviate the danger of secondary stricture, so that obstruction does not take place. In a considerable percentage of cases in which we have attempted direct union by making the opening in the duodenum the size of the opening in the hepatic duct obstruction followed and the operation had to be done over. This, apparently, has been the experience of others.

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AN ANALYTICAL STUDY OF FIFTY CASES OF URETERAL STRICTURE AND PYELITIS*

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THE object of this study is to point out:

First, the more common pitfalls which are likely to beset the surgeon when confronted by lesions within the abdominal cavity;

Secondly, to forcibly direct attention to the frequent and close relationship existing between lesions of the kidney and ureter and remote foci of infection.

So constant has been this association in the study of the cases forming the basis of this report that one is almost driven to the conclusion that they stand in the relation of cause and effect.

Pathologic lesions within the renal pelvis and of the ureter undoubtedly occur with greater frequency in the female than in the male, and more often on the right side than on the left. Just why this should be has not, as yet, been fully and satisfactorily explained.

Keyes, in his admirable article "Infections of the Kidney," contributed to "Cabot's Urology," views with favor the theory advanced by Volkow and Delitzen that the shallowness of the lumbar recess in women as compared with men, and on the right side as compared with the left, is competent to explain the preponderance of both right-sided renal mobility and infection. Still another unquestioned mechanical factor is the more frequent occurrence in the female of a movable cæcum and ascending colon, which, by dragging upon the kidney, materially interferes with both renal circulation and drainage.

These theories, however, do not explain the very frequent bilateral involvement often seen in the more chronic forms.

The frequency with which one encounters obstructive lesions in the ureter, and the satisfactory results obtained from appropriate treatment and the establishment of adequate drainage, justify the conclusion that strictured conditions of the ureter may likewise be potent factors in the production and perpetuation of these infections whether unilateral or bilateral. Certain it is that the "mechanics" of renal infection should never be lost sight of. Any physical factor which, by its presence, tends to impair the normal functioning of the kidney, whether it be of circulation or drainage, should be taken into serious account and remedied if possible.

In the series now under consideration, all were in females, as the writer's cystoscopic work is confined exclusively to this sex.

* Read before the Southern Surgical Association, December 14, 1920.

Of the fifty cases, thirty-nine, or 78 per cent., were unilateral; twenty-six, or 52 per cent., occurring on the right side, and thirteen, or 26 per cent., occurring on the left. Eleven of the fifty, or 22 per cent., were bilateral. It will thus be seen that the ratio of incidence of the right-sided lesion as compared with the left is as 2 to 1, and that of bilateral to unilateral incidence is as 1 to 4.5, approximately.

It is the right-sided lesion that furnishes the ready trap for the hasty and impulsive surgeon. If the patient be experiencing an acute attack in which the strictured area becomes inflamed and swollen, with the damming up of infectious products within the kidney pelvis, thereby producing exquisite pain, considerable temperature and a pronounced leucocytosis, the appendix will almost certainly be bottled within twelve to twenty-four hours. The mimicry here displayed is such as to mislead the most astute, unless one be eternally on his guard.

In this series, seven, or 14 per cent., had been subjected to this unnecessary ordeal; two of the seven being mistakes committed by the writer himself.

Points of importance in differentiating between these two lesions are the following:

(a) Careful microscopical examination of a catheterized specimen of urine.

(b) Absence of marked right-sided abdominal rigidity when the lesion is retroperitoneal. The acutely inflamed appendix rarely fails to produce demonstrable rigidity in the lower right quadrant.

(c) Hyperpyrexia points to infection within the kidney pelvis; rarely to the appendix.

(d) The Murphy sequence of onset of symptoms when the lesion is appendiceal; that is, pain, nausea, vomiting, elevation of temperature.

In the more chronic forms of this affection, where the patient's suffering has been allowed to drag through a period of months or years, the honors of surgical immolation are divided between the appendix, on the one hand, and the reproductive organs, on the other.

Of this series, eleven, or 22 per cent., had been operated for "chronic appendicitis" alone (exclusive of the seven, or 14 per cent., operated for "acute appendicitis"). In six, or 12 per cent., the diagnosis of "chronic appendicitis" had been made and operation advised. In nine, or 18 per cent., the primary surgical assault had been made on the reproductive organs alone. In three, or 6 per cent., two or more operations had been performed in the effort to eradicate the cause.

All told, therefore, twenty-seven, or 54 per cent., had either been operated upon or had had operation advised as the necessary remedial measure.

These figures tally closely with the experiences of other men whose statistical material is larger. Braash, of the Mayo Clinic, states that at least 50 per cent. of all the right-sided renal and ureteral lesions applying to this clinic for relief have previously been subjected to one or more futile

operations. Hunner, of Baltimore, in his experience, finds the percentage even higher. These figures bespeak a too high percentage of error on the part of the general surgeon, and present an appealing argument for the more frequent use of those agencies which have placed the diagnosis of lesions of the urinary tract within the realm of an exact science.

The second important fact revealed by this study is the consistent occurrence of one or more foci of infection somewhere within the body.

The puzzling feature of most of the experimental and scientific work done in the realm of urinary infections has been to harmonize the constant and dominating presence of the colon bacillus in these urines with the types of organisms controlling the field in the organ or organs suspected of being the originators of the mischief. Why, if a streptococcic laden tonsil be the *fons et origo* of this type of renal pathology, cannot we oftener demonstrate streptococci in the urine?

With the work of Rosenow upon the elective localization of streptococci we are all familiar. Yet he, after injecting 220 different strains of streptococci into 883 animals, found lodgment in the kidney in only 9 per cent. One of the most convincing pieces of work, bearing immediately upon focal infection and pyelonephritis, has just been completed by Bumpus and Meisser, of the Mayo Clinic. Their studies were based upon a series of cases presenting subacute lesions of the urinary tract with dental or tonsillar sepsis, and colon bacilli predominating in the urine. Not only were they able to produce in the majority of the animals injected definite renal lesions from cultures taken from the teeth or tonsils, but in two of their cases, showing marked exacerbation following tooth extraction, they were able to recover streptococci from the urine, which, when injected into animals, produced lesions of the urinary tract identical with those obtained from cultures of the teeth.

These experiments show conclusively that streptococci isolated from infected tonsils and teeth manifest a striking selective affinity for the urinary tract; for, of twenty-six animals injected with the primary cultures, twenty-four had lesions of the kidney and eight showed lesions in both kidney and bladder.

Further, they were unable in those patients whose urine showed only colon bacilli to produce in animals any definite renal lesions by intravenous injection of cultures from this source.

The ureters, in some instances, also showed definite hemorrhagic lesions, their walls being both inflamed and thickened.

In the series now under consideration the tonsil must be awarded first place; as in twenty-one, or 42 per cent., this organ manifested, both by its appearance and behavior, unmistakable evidence of disease. In the majority of cases there was a definite history, not of one, but of many attacks of acute tonsillitis, and the tonsil was not considered blamable until judgment had been passed by a competent throat specialist.

Next in importance come the teeth; eleven, or 22 per cent., revealed

definite evidence of one or more—sometimes several—apical abscesses. No conclusions were drawn concerning the mouth without the corroborative evidence of the X-ray.

In seven, or 14 per cent., both tonsils and teeth presented definite evidence of disease, and in the tabulated report accompanying this paper the honors have been equally distributed between these organs.

In two, or 4 per cent., sinus infection—one frontal and one antrum—was the apparent source from which the urinary lesion sprang.

In only nine, or 18 per cent., was evidence lacking of a definite focus which readily might be held responsible, and these have been classed as “uncertain.” Even this small percentage could likely have been reduced had the same degree of care been exercised in a search, in the earlier cases, for the probable focus of infection as was done in the later cases.

The average number of years which the trouble had persisted was eight and one-quarter; the shortest being one year, the longest twenty-five. One sees at once that chronicity, due largely to a failure to grasp the underlying pathology, is an outspoken characteristic of these lesions. When diligence is observed in recording the history, the beginning of the kidney lesion is often to be found faithfully reflected in one or more attacks of tonsillitis in childhood, complicated by a continued but irregular fever, back or loin pain, and bladder disturbances. The age of adolescence and young womanhood confers, seemingly, a period of greater or less immunity, but quite certainly to be lighted up later during the child-bearing age. The common picture of pyelitis of pregnancy does not originate *de novo*. The insult added to an already crippled drainage system by the changed mechanics of the pelvis brought about by the gravid uterus is quite sufficient to light up the smoldering flames, provided the primary focus be still present.

In 30, or 60 per cent., either pus was found in the urine at the time of renal catheterization or the history pointed to one or more definite attacks of pyelitis. The story unfolded by many of these cases as to the character, location and the behavior of their pain is as straightforward and as valuable, diagnostically, as is that of the duodenal ulcer or of the crippled appendix. The cases of considerable duration and with a definite history of antecedent pyelitis usually showed pus from the affected side at the time of ureteral catheterization. Those of shorter duration and with a negative pyelitis history, even though manifesting definite ureteral strictures, frequently gave negative urines and culture.

Culturally, the colon bacillus was found in twenty-three, or 46 per cent.; the staphylococcus albus in three, or 6 per cent.; and in twenty-four, or 48 per cent., no growth was obtained. The appearance of the staphylococcus albus in three cases was, in all probability, due to accidental contamination at the time of collecting the urine, as this organism is short-lived and plays a very minor rôle in infections of the renal pelvis. In no instance was the streptococcus recovered; due, possibly, to the fact that

JAMES NORMENT BAKER

TABLE I

Number	Age	Sex	Side involved	Bilateral	Number years existing	Probable focus	Pus found in urine or definite history of pyelitis	Location of stricture above bladder	Organism found on culture	Previous operations performed for relief
1	35	F	.	Yes	5	Tonsils	Yes	4 and 5 cm.	Colon	None.
2	53	F	..	Yes	15	Teeth	Yes	10 and 12 cm.	R. colon, L. colon	Appendectomy recommended.
3	20	F	Right	...	2	Tonsils	Yes	3 cm.	None	Appendectomy.
4	41	F	Left	...	22	Tonsils	Yes	9 cm.	Colon	Uterine suspension.
5	37	F	Right	..	12	Tonsils	No	3 cm.	None	Curettement.
6	36	F	Right	..	15	Tonsils	Yes	12 cm.	Colon	Amp. cervix and repair perineum.
7	20	F	Right	..	3	Tonsils	No	3 cm.	None	Operation for appendectomy recommended.
8	37	F	Right	..	10	Uncertain	No	15 cm.	Staph. alb.	None.
9	38	F	Right	..	15	Teeth	No	10 cm.	None	Appendectomy recommended.
10	38	F	Left	..	3	Sinusitis antrum	No	5 cm.	None	None.
11	33	F	Right	...	9	Uncertain	Yes	15 cm.	None	Appendectomy.
12	18	F	Right	..	2	Prob. tonsils	No	3 cm.	None	Appendectomy.
13	34	F	Right	....	14	Tonsils and teeth	No	7 cm.	None	Appendectomy and kidney anchored.
14	23	F	Left	...	3	Tonsils	No	3 cm.	None	Appendectomy and ovariectomy.
15	40	F	Right	...	12	Prob. teeth	Yes	8 cm.	Colon	None.
16	46	F	Left	..	5	Teeth	Yes	3 cm.	Colon	None.
17	34	F	Left	...	3	Teeth	Yes	3 cm.	Staph. alb.	None.
18	33	F	Right	..	14	Uncertain	Yes	3 cm.	Colon	None.
19	35	F	Right	..	10	Teeth and tonsils	Yes	4 cm.	Colon	None.
20	20	F	Right	..	2	Tonsils	No	4 cm.	None	None.
21	43	F	Left	.	10	Teeth	Yes	11 cm.	Staph. alb.	Curettement.
22	32	F	Right	.	10	Tonsils	Yes	4 cm.	None	None.
23	18	F	Right	.	4	Tonsils	No	13 cm.	None	Appendectomy.
24	42	F		Yes	15	Teeth	Yes	R. 3 cm., L. 3 cm.	R. colon, L. colon	Appendectomy.
25	41	F	Right	.	10	Teeth and tonsils	No	5 cm.	None	None.
26	24	F	.	Yes	4	Tonsils	Yes	R. 5 cm., L. 3 cm.	L. none	Appendectomy.
27	44	F	Right	..	12	Teeth and tonsils	Yes	5 cm.	Colon	Appendectomy.
28	22	F	Right	...	4	Tonsils	No	5 cm.	None	Appendectomy.
29	24	F	Right	.	1	Tonsils	No	4 cm.	None	None.
30	28	F		Yes	8	Uncertain	Yes	R. 3 cm., L. 8 cm.	Colon	Appendectomy.
31	32	F	Right	.	11	Teeth	Yes	3 cm.	Colon	None.
32	26	F	Left	.	17	Tonsils	Yes	3 cm.	None	Appendectomy ovariectomy.
33	35	F	Right	.	6	Tonsils	No	12 cm.	None	None.
34	53	F		Yes	25	Uncertain	L. pus R. none	R. 7 cm., L. 4 cm.	R. colon, L. colon	Curettement.
35	32	F		Yes	12	Teeth	R. pus L. pus	R. 4 cm., L. 3 cm.	R. colon, L. colon	None.
36	19	F	Right	.	6	Tonsils	Yes	3 cm.	Negative	Appendectomy advised.
37	30	F	Right	.	10	Tonsils and teeth	Yes	4 cm.	Colon	Appendectomy.
38	60	F		Yes	15	Tonsils	Yes	R. 3 cm., L. 3 cm.	R. colon, L. neg.	Appendectomy, bilat. ovariectomy, hysterectomy.
39	27	F	Left	.	8	Prob. teeth	Yes	12 cm.	Colon	None.
40	49	F	Left	.	3	Teeth	Yes	4 cm.	Colon	None.
41	52	F	Left	.	20	Teeth	Yes	4 cm.	Colon	Right nephrectomy.
42	33	F	Right	.	11	Frontal sinus	Yes	3 cm.	Colon	Double ovariectomy and appendectomy.
43	32	F	Right	.	7	Prob teeth	No	4 cm.	None	Appendectomy.
44	18	F	Left	.	1	Tonsils	No	3 cm.	Colon	None.
45	24	F	Right	.	9	Tonsils and teeth	Yes	R. 4 cm., L. 11 cm.	Colon	Appendectomy and right ovariectomy.
46	32	F	..	Yes	5	Tonsils	No	R. 4 cm., L. 4 cm.	None	Appendectomy.
47	23	F	Left	.	16	Tonsils	No	3 cm.	None	Susp. of uterus.
48	13	F		Yes	4	Tonsils	No	None	Colon	None.
49	35	F		Yes	12	Tonsils	Yes	R. 6 cm., L. 13 cm.	None	(a) Appendectomy.
50	38	F	Left	.	4	Teeth	No	3 cm.	None	(b) Doub. ovariect. None.

URETERAL STRICTURE AND PYELITIS

no cultures were made in any of the pyelitis cases during an exacerbation.

Finally, in forty-nine, or 98 per cent., an appreciable obstruction could be demonstrated at some point within the ureter above its entrance into the bladder, by means of the wax bulb implanted upon the catheter.

In thirty-five, or 70 per cent., the obstruction was from 3 cm. to 6 cm. above the bladder opening or within the broad ligament area. In fourteen, or 28 per cent., the obstruction occurred from 9 to 12 cm. at or near the pelvic brim.

The only case in the series failing to reveal ureteral obstruction was that of a child of thirteen, with bilateral pyelitis.

CONCLUSIONS

1. The frequent occurrence of symptom-producing lesions of the urinary tract in the female demands an exact diagnostic study before resorting to surgery.

2. These lesions are largely dependent upon infections of an hæmatogenous origin, the primary foci of which must be diligently sought out and removed before permanency of cure can be hoped for.

3. Both clinical experience and experimental studies tend to incriminate tonsils and teeth as the chief offenders.

4. Not only are strictured conditions of the ureter of more frequent occurrence than has been generally supposed, but their presence, by mechanically impeding drainage, constitutes an important factor which must be reckoned with in the effort to clear away subacute or chronic infections of the urinary tract.

EXSTROPHY OF THE URINARY BLADDER WITH CARCINOMA*

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THE rare occurrence of a carcinoma in an exstrophy of the bladder and the ingenious device which rendered the patient fairly comfortable but nevertheless proved a menace, as it was probably the prime causative factor of the carcinoma, prompts the report of the following case history.

The patient, a man aged fifty years, presented himself for relief from ureteral obstruction on the right side. He had a congenital defect of the penis and bladder constituting complete epispadias and ectopia vesicæ. For this condition he had worn a metal urine collector of his own device (Figs. 1 and 2). As a result of the obstruction of the right ureter he suffered greatly from pain in the right kidney region. Examination showed a large red bleeding mass the size of a large hen's egg protruding from the abdominal wall in the region of the symphysis pubis (Fig. 3). This mass occupied the site of a congenital opening into the bladder into which the two ureters emptied. The open bladder communicated by an open channel with the dorsum of the penis, which was deficient. The urethra was lying open along the dorsum of the penis and gave it the appearance of having been laid open by a longitudinal incision from the base to the glans. The testicles and scrotum appeared normal.

The bladder was excised by a two-stage operation. At the first operation the right ureter was transplanted into the rectum; at the second, the left ureter was also transplanted into the rectum and the bladder excised. These operations were performed on the 5th and 23rd of March, respectively. The defect in the abdominal wall was filled in by a fascia lata transplant. On May 28th the man reported in splendid general condition. He had gained about twenty pounds in weight and was doing work on his farm. Most significant of all, he had complete urinary control, and could retain urine from ten at night until seven in the morning (Fig. 4).

This case presents one significant fact—that the carcinoma occurred in an exstrophy. During the later years, the patient's comparative comfort was principally due to a device of his own invention for catching the urine. This very ingenuity, however, probably caused the carcinoma, which undoubtedly was due to irritation from this metal collector. As for the operation itself, the transplantation of the ureters into the rectum has made it possible to offer to such unfortunate cases as this much more assured promise of relief than was possible by former methods.

* Reported before the Ohio State Medical Association, June 1, 1920.

EXSTROPHY OF THE BLADDER WITH CARCINOMA

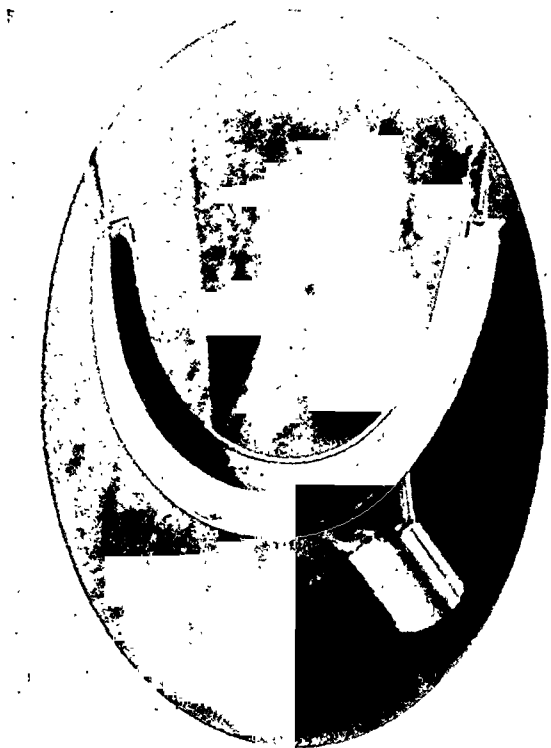


FIG. 1.—Metal urine collector devised by patient.



FIG. 2.—Metal urine collector shown in Fig. 1, as worn by patient.



FIG. 3.—Carcinomatous growth caused by friction of urine collector.

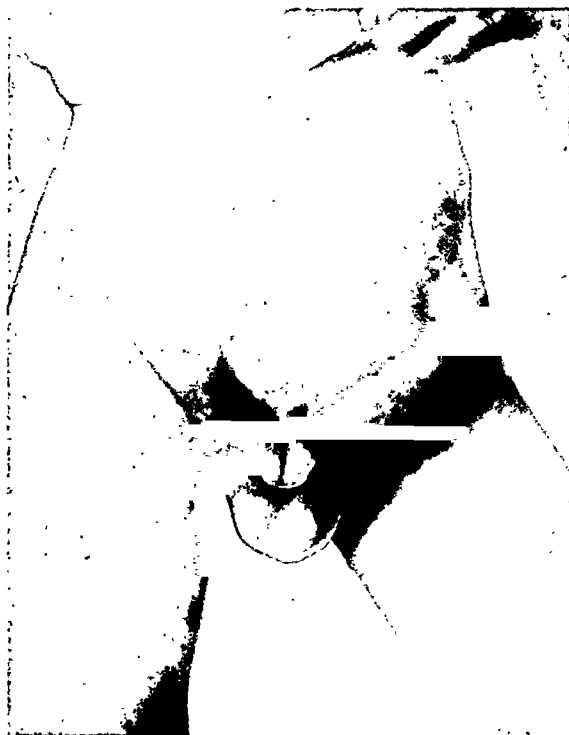


FIG. 4.—Post-operative results two months after operation.

At just how early an age the transplantation of the ureters can be successfully accomplished is still undecided. To transplant them in infancy means that the child will not only be constantly wet but badly soiled as well. Until the child has reached an age when he will control the anal sphincter, nothing will be gained by transplantation. When anal control is attained, however, transplantation of the ureters to the large intestine provides the utmost relief to the patient. This is true not only of cases of exstrophy of the bladder, but this method provides the greatest comfort also in certain cases of inoperable carcinoma of the bladder not accompanied by exstrophy. In these latter cases a suprapubic opening does not give the desired result, as it does not divert the urine from the raw surfaces.

Transplantation into the groin or into the loin requires the adjustment of a well-fitting retainer which at best is more or less of a nuisance. Transplantation into the large intestine offers the best result from the standpoint of the patient's comfort.

OPERATIVE TREATMENT OF GONORRHŒAL EPIDIDYMITIS

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SINCE 1918, when attention was called to the operative treatment of gonorrhœal epididymitis by the author in an article published in the ANNALS OF SURGERY, numerous operators have published accounts of their experience with the operation as described at the time, or with procedures which differ from it in minor detail.

The author has operated upon approximately one hundred cases of epididymitis by this modification of the Hanger operation since the original contribution was published.

The reports in the literature, together with the author's experience, have served to emphasize the conclusions reached in the paper of 1918, with the exception that operation is now believed to be the best method of treating gonorrhœal epididymitis in any stage.

Two clinical observations, with their theoretical interpretations, served as the basis upon which the operation was first undertaken.

1. That in medically treated epididymitis, the meatal discharge stops with the onset of the swelling of the epididymis.

2. That when the swelling of the epididymis begins to subside, the meatal discharge returns.

It remains only necessary to hypothecate that the swelling of the epididymis, by occluding the radicles of the vas deferens, prevents meatal discharge; and, that reestablishment of drainage through the vas deferens is brought about by subsidence of the occlusive swelling in the epididymis.

It is only necessary to see one acutely inflamed epididymis turned out of the scrotum at operation to realize the anatomical basis of this hypothesis, for it is quite apparent that the tightly stretched tunica closely binding the epididymis to the testicle, and squeezing the beginning of the vas in its embrace, will not permit drainage from the inflamed part. The fact that, in every instance, except the very chronic cases, the meatal discharge returns after operation which aims to relieve the pressure by releasing the tunica and puncturing the vas, proves the hypothesis.

The operation which has been found to insure the utmost relief of pressure and to return the patient to active life in the shortest time, is conducted through the widely incised skin of the scrotum. A general anæsthetic is advisable because the pain of the average acute epididymitis is such that local infiltration anæsthesia is inadequate. However, combined local and nitrous oxide anæsthesia gives very satisfactory results in the acute cases and is ideal for the old chronic ones, where the operative treatment may be combined with vasopuncture.

The skin is opened in an anterior scrotal line, and is separated by blunt dissection from the underlying tunica in order to partially turn out the testicle and to facilitate the recognition of the tunica albuginea.

In the normal testicle dissected at the post-mortem table, the recognition of the proper tunica for excision and suture is easy, but the diseased scrotal contents densely adherent by inflammatory exudate, or scar tissue, make a much more difficult problem. It is of utmost importance that the covering of the testicle should not be opened, because of the danger of infecting the tubules or furnishing an hernial exit for them. If covering is accidentally opened, it should be immediately closed with catgut before proceeding. In the majority of cases, however, there is an accumu-

lation of fluid under the tunica which, when tapped by the incising scalpel, gives a key to the proper layer to be removed. This fluid is variable in its amount and character; it is usually of considerable amount and of the typical hydrocele color and consistency. There may, however, in the more acute cases, be only a few drops of sero-sanguinous fluid or frank pus. All of these fluids, on culture, will grow gonococci, thus furnishing adequate reason to prevent their retention or reformation in the scrotum.

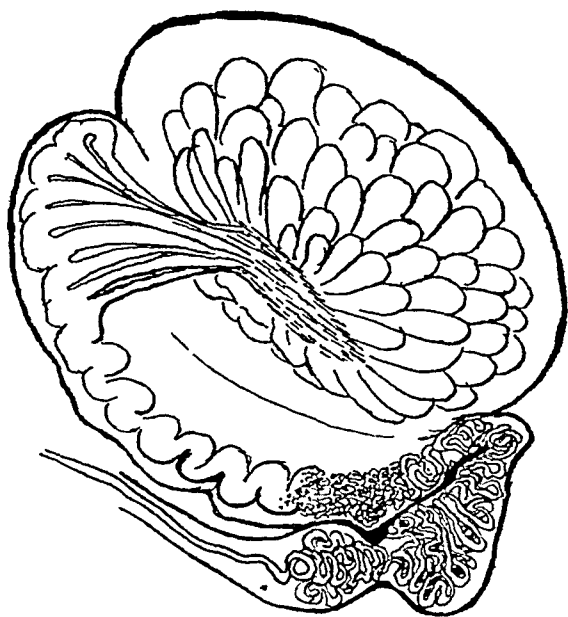


FIG. 2.—Showing how pressure of inflammatory swelling in the epididymis may occlude the radicles of the vas deferens.

Having, then, identified the proper tunica, it is dis-

sected free from the epididymis by sharp dissection; badly diseased and torn portions are excised, and that which remains is turned back and sutured loosely behind the cord with catgut, thus preventing a recurrence of the hydrocele. Before suturing the tunica, it is well to do vasopuncture if it is intended to combine the two procedures.

Having protected the structures of the cord by suturing the tunica over them, the next step is to relieve the inflammatory pressure in the epididymis itself. A few very superficial incisions are made in the epididymis with a scalpel, and through one of these a dull probe is introduced, pushing aside the tubules, but not perforating them. Frequently, small collections of pus are evacuated from pockets among the interstices of the tubules. The probe is made to explore the entire extent of the epididymis, and a drain of folded rubber tissue is now introduced into



FIG. 1.—Radicles of the vas deferens occluded by swollen epididymitis.

the epididymis and caught in place by means of a catgut suture; through it, and the covering of the epididymis, the testicle is returned to the scrotum, the drain being led out at the lower angle of the incision and the skin is closed with silkworm-gut sutures.

The relief from pain in the acute cases is immediate. The temperature drops to normal in twenty-four to thirty-six hours, and by the time the drain is taken out upon the fourth or fifth day, the epididymis is much reduced in size. The drainage of purulent material frequently follows removal of the drain for a week, or even two weeks, but this does not prevent the patient from being up and about in one week, and being at work in another.

The course of the accompanying urethritis is favorably influenced by the operation of epididymotomy in the more chronic cases, and frequently the operative treatment of the epididymi, together with bilateral vasopuncture, will usually clear up the persistent mournful morning drop of a year's standing or more. In several cases of treatment by bilateral epididymotomy, the author has secured specimens of the semen and found them to contain living spermatozoa.

It is safe, then, to conclude that epididymitis may occur on the unoperated side, but it has never been known to recur in the side upon which the operation of epididymotomy has been done. It is then safe to conclude that epididymotomy is the method of choice in treating any type or stage of epididymitis; that inflammatory swelling of the epididymis prevents meatal discharge, and that speedy relief from pain, and return to normal, follow operation.

COMPRESSION FRACTURE OF THE FIRST LUMBAR VERTEBRA WITH DELAYED SYMPTOMS (KUEMMEL'S DISEASE)

BY RUDOLPH V. GORSCH, M.D.

OF NEW YORK CITY

THE following case history is presented not only to add to the number of cases already reported, but also to emphasize the difficulty and importance of early diagnosis in spinal injuries and especially compression fracture of the vertebral bodies.

CASE I.—W. L., male, aged fifty-six years. Three months before coming under my care the patient sustained an injury to his back, having been thrown from a derailed freight car. He was taken to a local hospital where his surgical attendants informed him that no bones were broken in his back. Röntgenograms were taken but apparently revealed no fracture. He was under treatment at the hospital for six weeks complaining chiefly of moderate pains in his back, but was finally discharged as cured.

Two months later, however, the pains recurred in a severer form and were accompanied by numbness along the lower border of the ribs. He also noticed at this time a "hump," as he called it, at the site of his old injury.

A month later he came under my care and the following physical findings were noted: In the lumbar region of the spine there is a distinct kyphos. The vertebral spines are made out with difficulty. Motion is distinctly limited and on deep pressure there is moderate tenderness over this area. A röntgenogram reveals an old crushing fracture of the first lumbar vertebral body.

Comment.—One is impressed in reading over the cases reported with the failure to make an early diagnosis even with the aid of röntgenograms. The main reason for this is the lack of marked persistent sensory or motor symptoms referable to cord injury, the condition being lightly passed over as a "back sprain," arthritis, contusion or something else. The patient is not "sick enough" to have fractured a vertebra.

Furthermore, there are none of the usual signs of fracture present. The X-rays offer the only positive means of making an early diagnosis, and their frequent failure is not so readily accounted for. Probably, as in fracture of the skull, there are conflicting shadows or, as Baker sets forth* in a recent article, there is no early röntgenographic evidence of a bony lesion.

* R. H. Baker: Compression Fracture of Vertebral Bodies with Delayed Symptoms. Report of Seven Cases. (Kuemmel's Disease.) Surgery, Gynecology and Obstetrics, October, 1920, vol. No. 31, No. 4, p. 359.

COMPRESSION FRACTURE OF LUMBAR VERTEBRA

The late diagnosis made two months to two years following the original injury is comparatively easy. The diagnostic points are: A definite history of spinal injury, a distinct kyphos at the site of trauma with limitation of motion, muscular spasms, tenderness over the affected vertebra, and pains of varying intensity radiating to either side along the

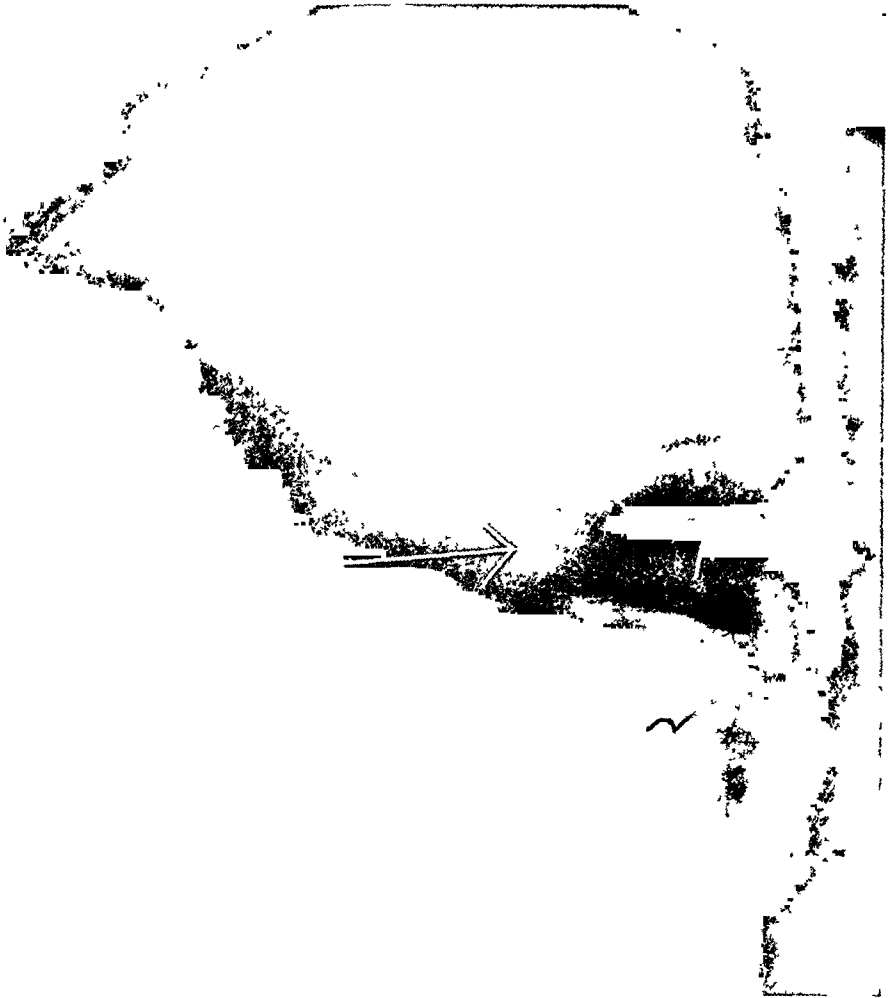


FIG. 1.—Radiograph three months following injury. Note the wedge-shaped outline of first lumbar vertebra opposite arrow.

course of the respective nerves. Finally, there is a distinctive röntgenogram of which the accompanying is typical.

It would seem advisable in all cases of spinal injuries where the diagnosis is in doubt to give a guarded prognosis and to treat the case as one of fracture by efficient and rather prolonged fixation, which would undoubtedly prevent much of the subsequent pain and deformity.

RÖNTGENOGRAPHIC STUDIES OF BRONCHIECTASIS AND LUNG ABSCESS AFTER DIRECT INJECTION OF BISMUTH MIXTURE THROUGH THE BRONCHOSCOPE*

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AND

WILLIAM H. STEWART, M.D.

OF NEW YORK, N. Y.

DOCTOR STEWART's first experience in outlining the bronchial tree with bismuth mixture was purely accidental. In October, 1915, while fluoroscoping an old man with an œsophageal obstruction, he observed some of the bismuth paste passing from the œsophagus directly into the trachea through a fistulous opening, a portion of the paste passing down into the lower bronchi. A röntgenogram was immediately taken. The patient had three or four coughing spells, bringing up particles of bismuth paste and the following day he seemed none the worse for his experience. The examination was repeated about a week later with no ill effects.

Upon investigation Doctor Stewart found that a number of similar cases had been reported. It occurred to him at that time, that, with proper precautions, the injection of opaque substances into the lung through the bronchoscope, could be safely undertaken.

It was evident that advancement along this line was slowly being made, for in 1917 Dr. Sidney Yankauer treated a case of bronchiectasis by direct applications of iodine solution to the diseased area through the bronchoscope. In conjunction with Dr. Willy Meyer and Doctor Yankauer, this patient was carefully watched röntgenographically. Complete recovery occurred.

Between 1915 and 1920 two cases of tracheo-œsophageal fistula came under observation in which the main bronchial tree on both sides was outlined by bismuth paste escaping from the œsophagus through a fistula into the trachea. In early 1920, the same phenomena occurred in a case of carcinoma of the œsophagus, located just above the arch, complicated by laryngeal paralysis; also, in a patient suffering from carcinoma involving the laryngopharynx. In both these cases the bismuth paste entered the trachea beneath the epiglottis which was imperfectly closed. Repeated Röntgen examination of these two patients did not cause any ill effects.

During Doctor Stewart's army experience at Biltmore, N. C., while examining patients suffering from chronic empyema, he frequently injected bismuth mixtures into an empyemic cavity which had direct communication through a pleuro-pulmonary fistula with a branch bronchus.

* Read before the American Röntgen Ray Society, September, 1920.

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The bismuth mixture would permeate many of the bronchial branches, be retained long enough to enable him to obtain satisfactory röntgenograms, and then would be expectorated. Such an occurrence, whether accidental or intentional, did not seem to seriously disturb the patient.

The experience mentioned above strengthened his belief that if accidental entrance could occur without danger, injections might be done deliberately and, combined with Röntgen examination, be used for diagnostic purposes.

Dr. Chevalier Jackson, of Philadelphia, during 1918, reported a case before the American Laryngological Association, in which the main bronchi on the right side were outlined röntgenographically, after insufflating dry bismuth through the 'scope.

Drs. J. C. Bullock and C. Gottlieb, of New York, in 1919, reported some experimental studies on living animals in which the bronchi had been injected with bismuth and barium mixtures, röntgenographic observations of which brought out details of the bronchial tree heretofore never thought possible.

So far as we are able to ascertain, it was not until early in 1920 that any successful efforts were made to röntgenographically outline lung cavities after the injection of opaque substances through the bronchoscope. In May, 1920, Doctor Lynah, of New York, presented a short preliminary report on the subject before the American Laryngological Association; he reported two cases of lung abscess which had been successfully mapped out röntgenographically after the injection, bronchoscopically, of aqueous and oily mixtures of bismuth subcarbonate directly into the area of diseased lung; both these patients have since been repeatedly examined by the authors and are included in the five cases reported in this communication.

CASE I.—A man, aged twenty-six years, who developed a lung abscess in July, 1919, after having aspirated sea-water while in swimming. He went out too far, became exhausted and went under; was hauled out and, by first-aid measures, soon revived.

One week later he suffered from what was supposed to be broncho-pneumonia; there was a great deal of foul expectoration at that time.

Within one month the acute symptoms had subsided, but he continued to expectorate large quantities of pus. He was sent to New Platz, N. Y., with a diagnosis of pulmonary tuberculosis even though no tubercle bacilli were found in the sputum. There he had several hemorrhages: the sputum showed numerous streptococci. He had fever and complained of having a "bubbling" sensation in his right chest. There were several night sweats. In February, 1920, the patient consulted Dr. F. W. Corwin, of Newark, N. J., who referred him to Doctor Lynah for bronchoscopic examination.

Röntgenographic studies made by Doctor Corwin showed a definite shadow over the right lower lobe surrounded by a "pus-soaked"

area of infiltrated lung tissue. The diaphragm was attached and pulled upward. The röntgenologist in his report stated that there was a fluid level and gas bubble in an abscess cavity; this, however, Doctor Lynah was unable to make out. There was profuse expectoration of foul-smelling pus, and the patient stated that he had coughed up as much as would fill two large preserve jars every twenty-four hours.

He was bronchoscoped after further study of the röntgenograms. The bronchoscopist noted a profuse discharge of pus pour-

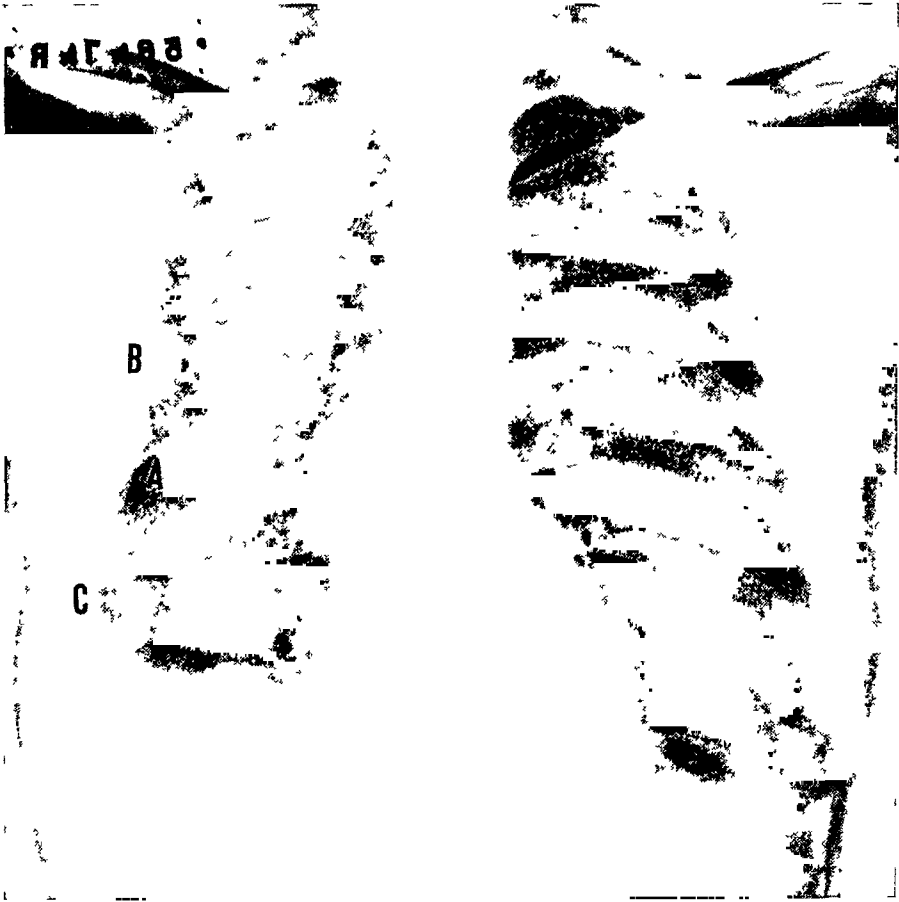


FIG. 1. (Case III).—Bronchiectasis before injection. A, area of diseased lung; B, resected ribs; C, thickened pleura with bands of adhesions "hooking up" the diaphragm.

ing out of the mouth of the 'scope. It was very foul smelling and blood tinged. A 7-mm. bronchoscope was introduced so as to be able to study and explore the lower lobe branches. After thorough evacuation of the pus-filled bronchi, the superior lobe branch on the right side was examined and found, on coughing, to be free from pus. Pus was noted coming out of the right middle lobe branch, which was directly anterior, but, after this branch was sucked out, and the patient instructed to cough, no pus was in evidence. The lower lobe branches were filled with pus; this was removed by suction and each branch examined in turn and the patient instructed

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to cough—by this means the branch bronchus from which the pus was coming could be definitely located. The small, but constant ejection of pus with each cough, pointed toward the right anterior branch; this branch was sucked out; however, pus appeared in the mouth of the bronchus with each cough in spite of suction; the long slanting end of the bronchoscope was then insinuated into this branch. It was now noted that there were many granulations present which bled freely. About one ounce of bloody pus was aspirated at this time into a sterile bottle and examined by Dr. George

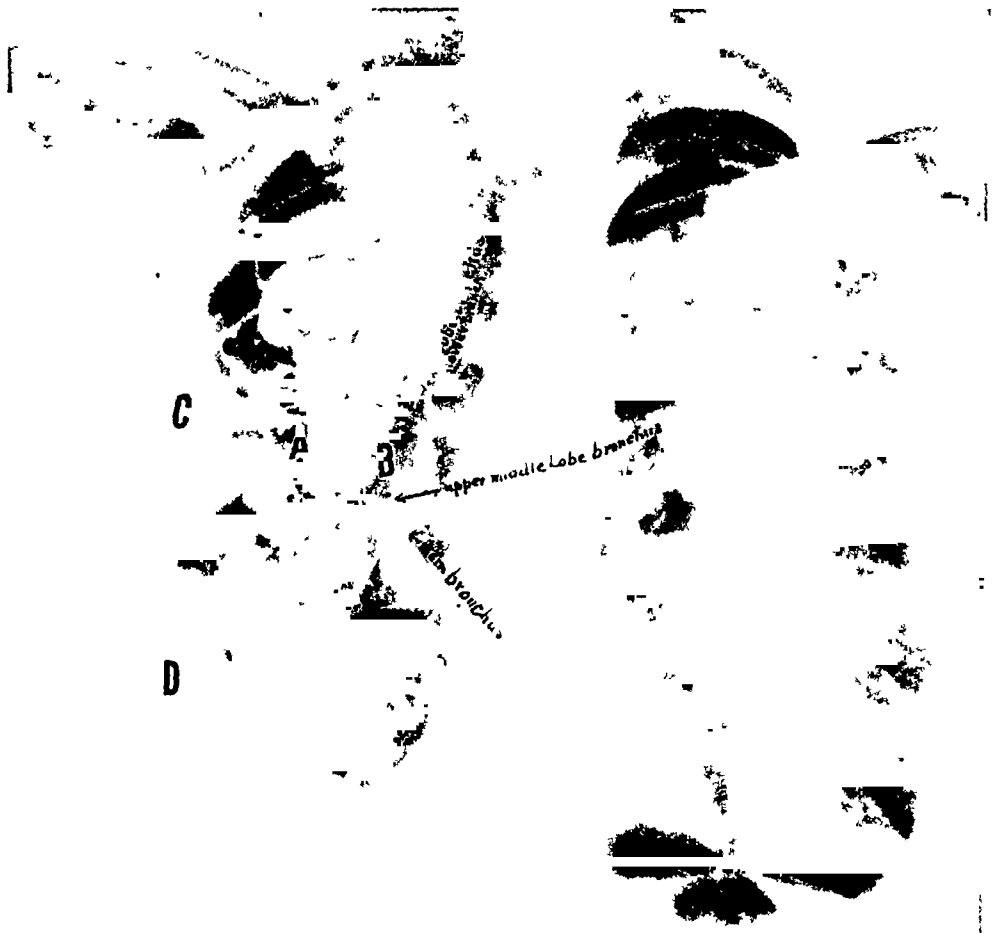


FIG. 2.—(Case III).—Bronchiectasis after injection. A, area of diseased lung cavities outlined with bismuth; B, right main bronchus with its upper and lower branches; C, resected ribs; D, thickened pleura with diaphragm "hooked up" with adhesions.

S. Dixon, of the New York Eye and Ear Infirmary, who reported as follows: "The pus removed bronchoscopically from the lung abscess of Mr. F. H. shows a pure culture of Friedlander bacillus." This was extremely interesting, for the most virulent cases which we see in the summer caused by swimming about New York Harbor are usually due to the Friedlander bacillus, one of the colon group. This man had a lung abscess caused by the inspiration of sea-water about New York harbor.

For definite lung mapping the abscess cavity was injected the following week with a mixture of bismuth subcarbonate in olive oil

(1-2). The right anterior branch was injected around a corner by a specially made curved spiral canula; 8 c.c. of bismuth mixture was injected slowly so as not to infiltrate the surrounding lung tissue, and within five minutes from this time the patient was fluoroscoped by Dr. Charles Gottlieb, and some very interesting observations made. By fluoroscopy the cavities filled with the opaque mixture could be distinctly seen. Röntgenograms were also taken in all positions and a set of stereoscopic plates made. Within ten minutes the patient was again fluoroscoped and the bismuth mixture was seen coming out of the abscess cavity and flowing upward.

He had not coughed up to this time for he was breathing as quiet as possible. He did have considerable cough, however, immediately after the removal of the bronchoscope, but the fluoroscopic studies made by Doctors Gottlieb, Corwin and Lynah, did not show any bismuth in the bronchi; it was only in the abscess cavities. While the bismuth was coming out of the abscess cavities into the bronchial tree, it was noted that it did not flow downward but upward, and röntgenograms taken at the time showed the middle and superior lobe branches well outlined by the opaque mixture while the lower lobe branches remained free. Shortly after, the patient complained of such bubbling, that he was compelled to cough, and expectorated about 2 c.c. of the bismuth mixture.

From these observations, Doctors Gottlieb and Lynah agree that probably there is another mechanism besides cough and the action of cilia, which causes expulsion of secretions from the tracheo-bronchial tree.

Röntgenograms taken before the injection did not show a definite outline of the abscess.

Another injection of bismuth was made one month later, at which time the röntgenographic studies were made by Doctor Stewart at the Lenox Hill Hospital, who reported as follows:

Fluoroscopic and röntgenographic examination, to ascertain how long the bismuth would remain in the abscess cavities and also how long it remained in the lobular structure into which it had infiltrated, showed that the bismuth mixture started to make its exit from the bronchial tree within a short time after injection. It remained much longer in the abscess cavities and lobular structures, but eventually disappeared. In abscess cavities it may remain from two weeks to two months, the shadow growing less opaque until it finally disappears. This perhaps accounts for the improvement of the patients and the diminution of the quantity of pus expectorated and the disappearance of odor. The injection of bismuth mixtures, while done for the purpose of outlining the lung in order to definitely locate the abscess cavities, seemed to have a beneficial effect on the patient. There was no odor to the pus expectorated after the second injection—this was so pronounced that the patient noticed it himself and said that he no longer had a foul breath, for the bad smell and taste had disappeared.

This case is still under observation.

CASE II.—A young lady of twenty years was seen in consultation with Drs. Willy Meyer and Richard Jordon. The patient was admitted to the Lenox Hill Hospital and bronchoscoped shortly thereafter. Röntgenograms showed what appeared to be a very large abscess in the left upper lobe well out toward the periphery, which from the "pus-soaked," spongy lung structure surrounding it, appeared much larger than it really was, and also suggested some pleural involvement.

The patient had had a tonsillectomy performed one week before admission by an expert laryngologist. At the time of admission she was expectorating 250 c.c. of pus every twenty-four hours, and her general condition was poor.

Bronchoscopy with a 7-mm. tube showed pus pouring out of the bronchoscopic tube; all the pus having been sucked out, the left bronchus was entered. There was an œdematous bronchial stenosis of the upper lobe orifice with a small opening from which free pus was expelled with each cough; in addition, a membranous plaque was present which also obstructed drainage from the upper lobe. The long slanting end of the 7-mm. tube was gently introduced into the mouth of the upper lobe orifice separating the œdematous stricture; the membranous plaque was removed by suction. After evacuating as well as possible the upper lobe branch, the lower lobe branches were examined but no pus was found in same. The upper lobe branch was again entered and the patient instructed to cough; with each expulsive cough there would be a gush of pus from this branch. The bronchus was apparently draining much more freely since the œdematous stricture had been opened. With a 10-inch vacuum the bronchus was once more aspirated and after fifteen minutes the bronchoscopic tube removed.

The following week the patient had improved somewhat, but the amount of pus had not greatly decreased.

Doctor Lynah again bronchoscopically aspirated the upper lobe branch, and then decided to inject the bismuth and oil mixture in order to röntgenographically map out the abscess cavity. With the curved spiral canula, 8 c.c. of bismuth subcarbonate in olive oil was injected too forcibly so that some of it squirted out of the spiral and passed downward into the lower lobe branches—leakage out of the spiral will not occur if the bismuth is injected slowly, nor will it infiltrate the lobular structures of the lung. The upper lobe branches of the lung abscess were also injected, the bismuth sticking to the wall of the cavity and thus marking it out. Several smaller abscesses were now noted, whereas, in the plate before injection, the cavity was interpreted as being very large. The bismuth mixture did not infiltrate the lobular structures in the upper lobe. Stereoscopic plates showed the abscess cavities well anterior and out toward the periphery, while the mass, which had leaked down into the lower lobe branches, was well posterior. A lateral plate taken at this time showed the relations of the upper anterior lobe abscess cavity, which was clearly defined, to the posterior dull,

opaque, fan-shaped are due to gravitation into the dorsal branch.

The bismuth was expelled from the lung, as in the other patient, within twenty minutes after the injection. As some of the bismuth had leaked downward into the lower lobe branches, it was impossible to state whether or not the bismuth started immediately to be expelled outward, as in the first patient, or whether it had gravitated into the lower lobe branches after it started to be expelled.

The patient was studied from time to time with the fluoroscopic screen and further röntgenograms taken. At the end of one week there was still bismuth present, both in the abscess cavity and in the lower lobe of the lung where no abscess existed; this looked somewhat like an abscess cavity, but was seen röntgenographically as an irregular area of opaque dulness and did not have the metallic lustre of the bismuth in the abscess; this is one of the distinguishing points between infiltration of bismuth into the lobular structure of the lung and bismuth in an abscess cavity.

The patient improved after the injection, in a manner similar to Case I. The pus decreased from her lung, and the amount of measured sputum in twenty-four hours decreased from 250 c.c. to 30 c.c. The odor was decidedly less and the patient's general health improved.

Bismuth was still present in the lung when fluoroscoped ten days after injection, although both shadows were diminishing in density and the lung abscess was apparently clearing up.

The patient suffered no discomforts following two injections of bismuth into her lung. She ate and slept well and had but little cough. She was bronchoscoped twice since the injection and we were not able to recover any of the bismuth by suction, even though it was still present in the lung. At a later bronchoscopic examination there was very little pus recovered by suction and no pus was expelled from the bronchus when the patient was instructed to cough.

The patient is still under observation.

CASE III.—A female, S. M., aged twenty-five years. On March 26, 1918, she had her tonsils and adenoids removed. Ten days following the operation the patient began coughing up small quantities of foul-smelling sputum, thick and yellowish in character; the amount gradually increased and occasionally the sputum was streaked with blood. There was pain and soreness in the lower part of chest.

She was operated on in May, 1919. Rib resection was performed and the cavity Dakinized; no abscess was found. The following September the incision was reopened and the tube placed in the cavity; there was no drainage; very little improvement occurred. In November, 1919, a new incision was made lower down with resection of a rib; a tube was left in the cavity, but no drainage occurred. In January, 1920, the incision was reopened and extended backward. An abscess was opened and a tube left in for drainage, which amounted to four ounces on the first day and two ounces on the second day. The discharge gradually decreased. The tube was removed and the wound healed.

About six weeks later she began coughing and raising foul-

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smelling sputum again and gradually became worse until she was admitted to the Lenox Hill Hospital, on May 17, 1920.

On May 22, 1920, a preliminary fluoroscopic combined with stereoröntgenographic examination showed evidence of pleuritic thickening involving the upper and middle lobes on the right side; the right diaphragm was partially fixed with adhesions. In the lower portion of the upper right and the upper portion of the middle right lobes there was increased density with here and there evidence of cavitation.

The patient was bronchoscoped on May 25, 1920. Abundant purulent secretion was discharging from the upper lobe. Eight c.c. solution of bismuth subcarbonate in sterile olive oil (1-2) was injected in the upper lobe bronchus; this was followed by a fluoroscopic as well as a stereoröntgenographic examination, which showed that some of the bismuth solution had reached the diseased area, but not sufficient to satisfactorily map out the cavities.

A Röntgen reëxamination, on June 9th, showed much the same condition as reported on May 22nd. Most of the bismuth had disappeared.

On July 8th the patient was again bronchoscoped, the main upper lobe being injected as previously. The stereoröntgenograms, taken almost immediately after the injection, showed with excellent detail the numerous cavities in the lower portion of the upper and the upper portion of the middle right lobes.

The patient is still under observation and shows continued improvement.

CASE IV.—A. L., a young girl, aged twenty years, was admitted to the Lenox Hill Hospital in June, 1920, with the following history:

Tonsils had been removed two years previously. Following the operation she was taken home in an open car, with considerable exposure. Pneumonia developed; the cough continued, and two weeks later she began expectorating large quantities of foul-smelling pus. This condition persisted up to the time of her admission to the hospital.

A preliminary fluoroscopic combined with stereoröntgenographic examination, on June 19, 1920, showed marked pleuritic thickening over the middle and lower right lobe; the right diaphragm was "hooked up" with adhesions and there was considerable increased density in the middle and lower right with evidence of cavitation, especially in the lower lobe.

On June 20, 1920, bronchoscopic examination showed pus coming from the middle and lower right lobes; none from the upper. A solution of 8 c.c. of bismuth subcarbonate in sterilized olive oil was injected into the bronchi of the middle and lower right.

Röntgen examination, made as soon as possible after the injection, showed the bronchi within the diseased area well outlined, with numerous cavities clearly demonstrated.

When the patient entered the hospital she expectorated 300 to 500 c.c. per day. Since the injection gradual improvement has

occurred with marked diminution in the quantity of expectoration.

The patient is still under observation.

CASE V.—E. E., male, aged twenty-four years, entered the Lenox Hill Hospital on June 18, 1920, with following history:

Had tonsils removed June 5, 1920; six days later developed a cough which became productive on about the ninth day. On admittance his chief complaint was cough with expectoration, and pain in joints.

June 23, 1920, a preliminary Röntgen examination was made which revealed a dense triangular area in the lower portion of the upper right lobe; in the centre of this pus-soaked, spongy area of infiltrated lung tissue a fluid level with an air bubble above could be made out, indicating a large abscess.

On June 29th he was bronchoscoped, a 9-mm. tube being used. Pus was seen coming from the right upper lobe bronchus only. About 10 c.c. of bismuth subcarbonate in sterilized olive oil (1-2) was injected into the right upper bronchus; this was followed by Röntgen examination which showed the lower bronchus outlined by the injection, but very little, if any, having passed into the diseased area.

He was again bronchoscoped on July 8th. Pus was still obtained from the right upper bronchus which was again injected with bismuth solution. Fluoroscopy and stereoröntgenograms showed bismuth outlining the numerous cavities; some of the mixture had infiltrated into the lobular structures well out toward the periphery of the upper portion of the dense area.

The quantity of sputa gradually diminished until July 19th, when it had practically disappeared and the arthritic symptoms had greatly improved.

A stereoröntgenographic reëxamination on July 26th showed gradual disappearance of the bismuth except where it had penetrated the lobular structures.

The patient is still under observation.

SUMMARY

1. Bismuth mixtures can be injected into the bronchi and lungs of a living patient without danger.

2. The injection of an opaque substance into the lung of the living patient will open an enormous field of usefulness in the study of cough, the expulsion of substances from the lung, and lung drainage. It will also aid in localizing bronchial strictures in the same manner as in the œsophagus. Furthermore, it will be of the greatest aid to the thoracic surgeon by mapping out the abscess cavity in the respective lobe of the lung.

3. A definite lung abscess cavity is seldom seen bronchoscopically. Pus is usually seen coming from a branch bronchus, although the abscess may be well around the corner, and not in that portion of the lung from

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which the pus is oozing. An injection of bismuth mixture or some other opaque mixture will "clear up" this error.

4. Bismuth when it enters the abscess cavity is recognized by its metallic lustre, whereas, when it is in the lobular lung structure, it is discerned as a dull, opaque area. Pus diffuses and soaks the lobular structure in a manner similar to bismuth; this often makes the involved area appear many times larger than it really is.

5. The bismuth mixtures injected in these patients was 8 c.c. of bismuth subcarbonate in pure olive oil (1-2). The mixture is rendered sterile by boiling before injection.

6. The injection should be made slowly and not with a "squirt" or else the röntgenographic observations may be spoiled by bismuth soaking the lung structure surrounding the diseased area.

7. It seems from these preliminary studies that cough and action of cilia are not the only means of expelling secretions.

8. While bismuth mixtures were originally injected for the purpose of lung mapping in cases of lung abscess cavities, they seem to have been of therapeutic benefit to the five patients upon whom they were tried. So far the procedure has done no harm.

9. While the fluoroscopic examination is important, stereoröntgenographic examination is the best means of localizing the cavitations.

10. Experience has shown that the Röntgen examination should be made almost immediately after the removal of the bronchoscope, otherwise the patient, in a fit of coughing, will remove much of the bismuth from the involved lung.

TECHNIC FOR REMOVAL OF FOREIGN BODIES UNDER DIRECT FLUOROSCOPIC GUIDANCE

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THE extreme difficulties incident to extraction of foreign bodies have long been well established. Stimulated by this fact, and the recent work of Braasch in removal of stones from the kidney, which emphasizes the applicability of this method to civil practice and the possibility of a wider field for operative fluoroscopic methods, I offer the discussion of the following technic, my knowledge of the method being based on experience gained from the removal of four hundred and eighty-five foreign bodies while Chief of the Surgical Service, Base Hospital 202, Orleans, France, and as Associate Chief of Service, General Hospital 41, Staten Island, New York.

After a trial of all the modern localization methods offered for extraction of foreign bodies, the method about to be described was adopted as being the surest, safest and quickest, and in our hands resulting in one hundred per cent. successful removals.

For the successful application of this technic, there is required a dark fluoroscopic room suitable for operating purposes, an operating fluoroscopic table with adjustable Röntgen-ray tube, a sharp pointed metal indicator, a headlight for the operator, and a screened light for the anæsthetist. If the operator is well trained in the use of the fluoroscopic screen, this technic might be undertaken without the aid of a röntgenologist, otherwise the advice and consultation of the röntgenologist is much to be desired.

Technic.—First, a careful fluoroscopic study of the case is necessary before time of operation to determine the advisability of extraction, the number and size of foreign bodies to be removed, and an important feature, the best method of approach; on this depends the success or failure of extraction.

Exact localization of the foreign bodies is done in the following way: With the patient under general anæsthesia, the room is darkened and the foreign body is focused in the direct ray between the tube and screen. Now the metal indicator is placed directly over the foreign body, the tube box is shifted in the long axis of the field, and the rate and distance of the foreign body and indicator are noted. The body of density, whether foreign body or indicator, nearer the tube, falling in the line of ray first, gives the appearance of travelling the faster, and hence a greater distance. At this stage the indicator is raised or lowered, depending on whether it or the foreign body is travelling faster. If faster, it is raised, and *vice versa*. This is continued until the indicator and foreign body move together at the same rate of speed and same distance, indicating that they are the same distance from the tube. This indicates that the foreign body lying in the

perpendicular or direct ray between the screen and tube lies also in a line continuous with the tip of the indicator, which is at a right angle to the line of direct ray. At this stage the switch is thrown and tube allowed to cool, while with the use of the headlight, a small incision through skin and fascia is made. Now, with a pair of heavy-jawed forceps placed in incision, the ray is again sent through and the forceps gently but firmly thrust in onto the foreign body. Now with a few movements of the forceps for blunt dissection, the foreign body is freed, grasped and withdrawn. The switch is thrown, a couple of sutures placed, or the wound drained, as indicated, and a dressing applied.

At times, owing to the position of the foreign body or its relation to bone, it cannot be approached at a right angle to the direct ray, and in this event the technic becomes somewhat more difficult, but in the hands of one skilled in the technic the operation is quickly and safely done, usually not consuming more than two to four minutes.

Reference to the above technic has recently been made by Dr. Herbert A. Potts, Chicago, Illinois, in a manuscript published by him on Oral and Plastic Surgery in France, in which he gave me credit for approximately four hundred extractions, but there was no effort at a careful description of technic.

The four hundred and eighty-five extractions above cited occurred in the following locations: pericardium, three; lung and pleural cavity, twelve; bone and joint, fifteen; soft tissue, four hundred and fifty-five.

There are certain locations in which foreign bodies lend themselves better to extraction by means of open dissection, the fluoroscope being used for fractional localization, or indicator. This is especially true as shown in the three cases of removal of foreign bodies from the pericardium. This is also true of foreign bodies in close proximity to the vital structures of the neck. In these cases the method of localization is the same, the operation being done on the fluoroscopic table, but through open dissection, with the fluoroscope used when needed. It can readily be appreciated that the blind approach, as described, might be a very hazardous undertaking in the case of foreign bodies in the pericardium, or deep structures of the neck.

Cases of foreign bodies in the lung deserve special mention, and certain special features in technic are necessary. The same method of localization is employed, the same method of blind approach, but with special precautions against an artificial pneumothorax. This is done in the following way:

At the point indicated on the chest wall the skin is grasped and held firmly while the incision is made. The skin still being held firmly, the forceps are thrust in through the muscle and pleura and the foreign body extracted. As the foreign body is withdrawn from the chest, the skin is again grasped firmly and is held firmly between the fingers, while two deep mattress sutures are placed, including skin and intercostal muscles. This precaution prevents the entrance of air in sufficient quantities to cause a perceptible degree of pneumothorax and it can be seen that the function of the lung is not disturbed. Owing to the intrathoracic pressure being main-

tained at approximately normal, hemorrhage is controlled. In no case of the ten of foreign bodies in the lung was there any appreciable embarrassment in respiration, or any appreciable hemorrhage. Of the five cases with associated pulmonary abscess the same technic was used with the exception of drainage tubes being placed, following resection of rib. In two of the five cases a two-stage operation was done, the first operation including resection of rib with establishment of adhesions between parietal and visceral pleura. This was followed at the proper time by removal of the foreign body by use of the above technic, with sufficient drainage.

I especially mention the advantages of the above method of localization and approach in isolated, small pulmonary abscesses over the old method of localization by aspiration. The abscess casts a distinct shadow, and can be localized and approached in the same manner as a foreign body.

In the cases of foreign bodies in joints and bones, either the blind method of approach or an open dissection with the fluoroscope as an indicator, can be used, depending on location of foreign body.

In foreign bodies in the medullary canal we have routinely used the open dissection, in some instances a window being cut by the use of the twin saw.

The method is not especially applicable to foreign bodies in the brain. It might be done successfully, but these cases lend themselves better to extraction by use of the magnet. The two cases of foreign bodies in the brain observed by me were showing no symptoms. The foreign bodies being rather inaccessible, no attempt was made at removal.

Even with the most accurate localization methods, most expertly done, there will result a certain large percentage of failures of extraction. This is brought about by several factors, namely, the variable contour of the field; often, change in position, due to change in position of patient on the table; change in position resulting from traction of wound edges; bad judgment as to method of approach, impossible of avoidance, incision often being made on wrong side of bone; and many mechanical factors that might be mentioned which tends towards failure. A foreign body in a sinus or tract might move, which would necessarily discredit any methods of localization. With the above technic, this is eliminated, for the reason that the foreign body is under the direct eye, and can be traced and followed. In the case of foreign bodies in the chest, pleural cavity or lung, with the localization method it is necessary to do an open thoracotomy with wide exposure, it being often necessary even to deliver a portion of the lung, resulting in shock, trauma, and of course a pneumothorax with collapsed lung.

We have all had very unhappy experiences in efforts at removal of foreign bodies, especially foreign bodies in hands and feet, and I am sure that a method so sure and accurate, resulting in so little trauma, should be accepted as worthy of adoption.

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held November 1, 1920

The President, DR. GEORGE G. ROSS, in the Chair

BONE TRANSPLANT FROM CREST OF ILIUM TO MANDIBLE

DR. ROBERT H. IVY presented a man, aged twenty-seven years, who when seven years of age had a large section of the left side of the mandible removed, comprising the full thickness of the bone, for a large growth which a well-known surgeon diagnosed as sarcoma, this diagnosis being confirmed pathologically. Since that time he has worn a prosthetic appliance which partially overcame the deformity and enabled him to masticate food fairly well. Of late years, however, changes in the shape of the jaw and in position of the teeth affected the fit of the appliance, so that it was rapidly becoming useless. Examination revealed (Fig. 1) an absence of something over two inches of the left side of the mandible from the canine region to the angle. A small portion of the ascending ramus with coronoid and condyloid processes was present, this fragment being movable at the joint. The remainder of the mandible showed great instability and a marked tendency to swing over to the left side, with consequent loss of facial balance and interference with function. The success attending bone grafting in cases of ununited gunshot fracture of the mandible during the recent war led him to attempt a bone transplant in this case. Cast silver splints were made by Dr. J. E. Aiguier, fixing the right side of the mandible in proper relation with the upper jaw. On March 17, 1920, at St. Agnes' Hospital, under ether intrapharyngeal anæsthesia, an incision was made over the region of lost substance, the ends of the fragments were exposed and freshened, and a graft $2\frac{1}{2}$ inches long was removed from the crest of the ilium and inserted to fill the gap, being attached to the fragments by means of silver wire. The wound was closed in two layers. Some suppuration occurred, part of the surface of the graft being exposed for several weeks, but the wound eventually closed, and the vitality of the graft was not interfered with. At the present time there is firm union at both ends of the graft, and the jaw is in good position (Fig. 2). An artificial denture will shortly be prepared. The operation left a depressed scar, adherent to the bone. On October 15, 1920, at the Medico-Chirurgical Hospital, the scar was excised, the edges were undermined for some distance, and after complete hæmostasis a strip of fascia lata from the left thigh was inserted into the pocket under the skin, being retained in place with a few catgut



FIG. 1.—Radiograph made by Dr. H. K. Pancoast, showing loss of substance in the lower jaw.



FIG. 2.—Radiograph made by Dr. H. K. Pancoast, showing graft in place. Clinically, firm union is present, although this is not altogether apparent in the radiograph as far as the anterior end of the graft is concerned.

sutures. The wound was closed with interrupted sutures of horsehair. In this manner the depression was obliterated. The wound healed without complications, the sutures were removed on the sixth day, and in ten days the patient was up and about.

Payr, of Griefswald (*Zeitschr. f. Chir.*, September 5, 1908), employed a piece of rib to replace loss of substance of the mandible. Oppel, of Petrograd, in 1910 used osteo-periosteal fragments from the clavicle. Vorschütz, of Cologne (*Deutsch. Zeitschr. für Chir.*, September, 1911), reports two cases in which a graft was taken from the crest of the tibia. In both cases the transplanted bone was extruded, but sufficient periosteum remained for regeneration to occur. Abadie, of Oran (*Bull. et mém. Soc. de Chir. de Paris*, 1912, xxxviii, 649), records the use of a free rib graft following resection of the mandible for follicular cyst. The functional and cosmetic results were good, although the bone was apparently absorbed and replaced by dense fibrous tissue.

CALCULUS IN WHARTON'S DUCT

DR. ROBERT H. IVY presented a man who for six days had complained of pain and swelling beneath the tongue on the right side of the mouth,

and a swelling in the right submaxillary region of the neck, all of which symptoms gradually grew worse. The swelling in the neck



FIG. 3.—Large dental X-ray film placed horizontally between teeth showing calculus. Made by Dr. L. M. Ennis.



FIG. 4.—Calculus.

partly subsided after two days, but again increased. The patient stated that he had had the same symptoms nine years before, but that they had passed away gradually without treatment. Examination revealed a small hard, tender lump just beneath the mucous membrane on the right side of the floor of the mouth opposite the second molar tooth. There was also a circumscribed, oval, rather soft, slightly tender swelling just beneath the angle of the jaw on the same side. Upward pressure on this made the lump in the mouth more prominent. At first radiographic examination was negative, but a second film placed well back horizontally between the teeth showed a large opaque body (Fig. 3) in the region of Wharton's

duct. Through an incision in the floor of the mouth a large oval calculus, 2.3 by 1.9 by 1.4 cm. in size and weighing 0.9 grm., was exposed and removed (Fig. 4). A small iodoform gauze drain was placed in the wound, which healed in a few days without complications.

Erdman has recently reported (*Jour. A. M. A.*, May 22, 1920, p. 1447) five cases of calculus in salivary ducts, and states that about three hundred cases have been recorded altogether. It is probable, however, that the condition is commoner than these figures would indicate, many cases occurring without being reported. About two-thirds of the cases involve Wharton's duct, 20 per cent. Stenson's duct, while in a small number the sublingual gland is involved. The largest stone in Erdman's series was 1.3 cm. in length. The principal component of salivary calculi is calcium phosphate, other substances being calcium carbonate and organic matter.

Important points in the diagnosis are the presence of a hard, tender swelling in the floor of the mouth associated with submaxillary enlargement which varies in size from time to time, and the radiographic findings. Combined internal and external palpation is of great value. Radiographic findings are frequently negative, owing to faulty technic. A large dental film placed horizontally between the teeth, as far back in the mouth as possible, and the rays directed from beneath the chin, will usually reveal the calculus. The commonest condition causing error in diagnosis is dento-alveolar infection with enlarged submaxillary lymph-nodes.

DR. EDWARD B. HODGE reported that he had had four or five cases; the youngest, a colored child nine years of age. Another case was in a nurse, who refused operation and suffered for a year and a half, when suppuration forced her to operation. Here the stone was found in the submaxillary gland, where it had been located by previous X-ray.

DR. JOHN B. CARNETT said that eight or ten years ago he saw three cases of stone in Wharton's duct in the course of a few months. In none of them was the stone nearly as large as the one shown. Skiagraphs taken of two of them were negative. There were four stones in the three patients, and in all three patients there was a characteristic mild colic while partaking of food. The submaxillary gland on the affected side enlarged in all three during meals, and in one case pain was so severe that the patient left the table frequently before completing the meal. In all three patients simple incision over the stone allowed its easy evacuation. The incisions closed up without trouble. All the patients were young adults and none had had any further trouble a year later, and one seen during past month has had no further difficulty.

FRACTURES INVOLVING JOINTS

DR. W. E. LEE and DR. WALTER LEVERING presented three fracture cases from the service of Doctor Lee, the first two treated at the Pennsylvania Hospital, and the last at the Germantown Hospital. Although

FRACTURES INVOLVING JOINTS

the fractures are of different regions, namely, just above the elbow, the knee and the ankle, respectively, there are certain points of similarity about them which are worth considering. (1) In all there was a history of violent trauma. (2) In all there was considerable displacement of the fragments. (3) In all a joint was involved either directly or indirectly. (4) The treatment was somewhat the same, namely, by reduction under general anæsthesia, and fixation with extreme flexion. (5) The end-results in all were satisfactory.

The first case, Miss J. W., aged twenty-one years, on March 11, 1920,

FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.

FIGS. 5, 6, 7, 8.—Supracondylar fracture of humerus extending into elbow joint.

while working at a bookbinding machine got her right arm caught and was drawn forward. The pain was so intense that she could not explain the manner in which her arm was twisted. She was brought to the hospital at once, and was dressed in the receiving ward on an anterior straight splint. Arm in extension. Receiving ward diagnosis, supracondylar fracture of humerus. She returned the following day, was X-rayed and admitted to the ward. The X-ray (Figs. 5 and 6) showed a supracondylar fracture of the humerus comminuted, of the T-shape variety, involving the trochlear surface of the joint. There was complete displacement, the lower fragments being anterior. At the end of a week she was dis-

charged from the hospital and sent to the dispensary. Here it was found that the deformity had not been corrected and she was returned to the hospital. On March 25th, fourteen days from the time of the injury, under ether anæsthesia, Doctor Lee reduced the deformity and dressed

FIG. 9.

FIG. 10.



FIGS 9, 10 —Ankylosis imminent



FIGS. 11, 12.—Range of motion on completion of treatment in case shown in Figs. 5 and 6.

the arm in Jones position. X-ray examination (Figs. 7 and 8) then showed excellent position of the fragments. Patient was then treated in the dispensary. X-ray examination on May 14th showed some absorption of the articular cartilages, and the rontgenologist suggested that ankylosis was imminent (Figs. 9 and 10). Massage and active and passive motion was

kept up, and a final X-ray taken October 30th shows what appears to be a perfect joint (Figs. 11 and 12). The patient has complete flexion, 170 degrees extension, and complete pronation and supination. She has returned to her original work and her earning power has not been reduced.

The second case, Mrs. E. B., aged thirty-one years, on March 6th was thrown from an automobile, landed on her feet and turned her ankle under her. She was brought to the hospital immediately, a diagnosis of Pott's fracture made, dressed in a Thomas splint, with a stocking extension. X-ray (Fig. 13) examination showed comminuted fracture of the right fibula, a short distance above the malleolus. There was also a fracture

FIG. 13.



FIG. 14.

FIG. 13.—Fracture of fibula and tibia involving ankle joint.
FIG. 14.—Result after operative correction of deformity.

of the tibia, at the tibiofibular articulation. There was marked backward displacement of the foot and distal fragment of the fibula. On March 12th, six days after the injury, under nitrous oxide anæsthesia, tenotomy of the tendon of Achilles was done, the deformity reduced, and the foot put in a plaster case in extreme flexion and internal rotation. X-ray examination (Fig. 14) showed excellent position of the fragments. The end-results at time of reporting this case show complete function and no deformity about the ankle.

The third case, a boy, A. Mc., aged eleven years, on July 18, 1920, fell from a hay loft a distance of about eleven feet. His left leg went into a post hole, and he was thrown forward. He was brought to the hospital

at once. Examination showed swelling and crepitus just above the left knee. The leg in hyperextension. X-ray examination showed an epiphyseal fracture of the femur and complete backward displacement of the upper fragment (Fig. 15); under ether anæsthesia the deformity was reduced and the knee dressed in acute flexion (Fig. 16). Patient was left in this position until the thirty-fifth day, when it was found he had contraction of the hamstring tendons and could not extend the leg. He was again anæsthetized and the adhesions broken up, the leg being dressed on a posterior splint and considerable pressure put on the knee to promote extension. After three weeks of this it was found the boy



FIG. 15.—Separation of the lower epiphysis of femur FIG. 16 —Separated epiphysis restored to place by acute flexion of knee

had a toe-drop, due probably to pressure of bandage on a nerve. He was discharged from the hospital in September and sent to the dispensary. At the time of his discharge X-ray (Fig. 17) shows good union and excellent position of the fragments. Function of the knee was complete; he still, however, has slight toe-drop. This is undergoing rapid improvement.

DR. A. BRUCE GILL said that orthopædic surgeons are frequently called upon to examine or treat cases of fractures in the neighborhood of joints, because the patients present a disability of the extremity which persists oftentimes many months after the fracture. This is particularly true of fractures at the wrist and the elbow. If a fracture at the wrist is succeeded by swelling of the hand and fingers which persists, not infrequently a condition of fibrous ankylosis of the joints of the fingers, particularly of the metacarpophalangeal joints, results. This ankylosis is due particularly to the swelling; that is, to the interference with circulation. The

disability which results from a Colles fracture is nearly always due to the ankylosis of the fingers rather than to any interference with the function of the wrist joint. If the fracture is properly reduced and proper dressing is applied, either the swelling does not occur, or if it has occurred, it subsides quickly after complete reduction is accomplished. If the swelling persists after a week or longer it should be considered as an indication that the fracture has not been reduced.

The surgeon cannot rely entirely on the X-ray examination. Sometimes the X-ray shows fairly good reduction of the fracture, but the swelling persists. At other times there is fairly marked displacement of the fracture, but there is no swelling of the hand, and the patient has no loss of function as a result of the fracture. The persistence of swelling should be a chief guide in the treatment of the fracture.

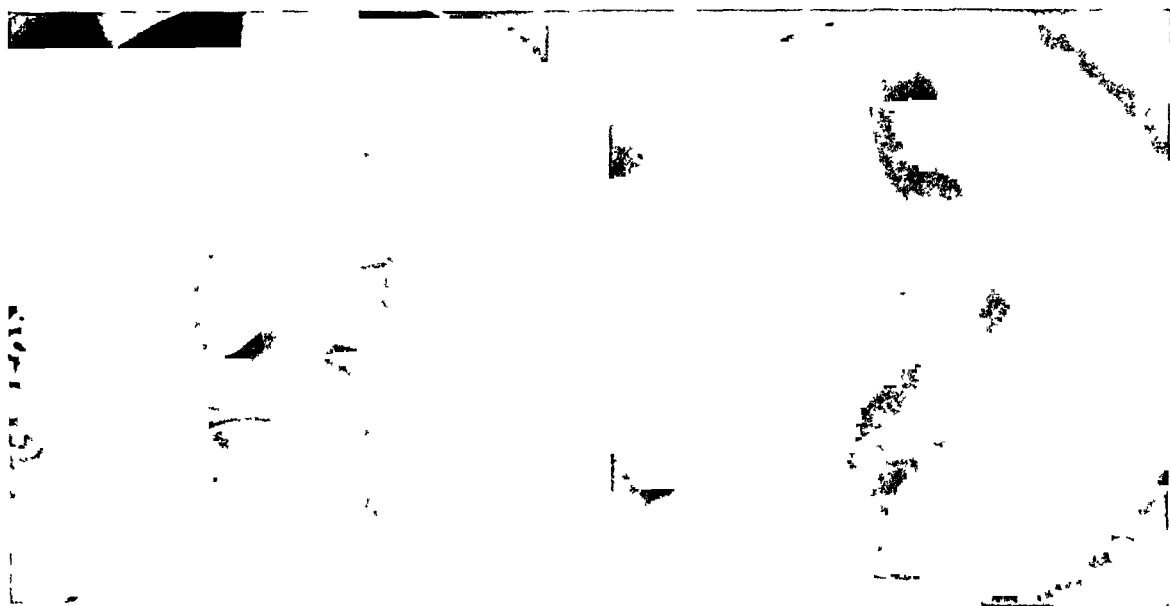


FIG. 17.—Ultimate result from treatment of case shown in Figs 15 and 16.

In a similar manner, fracture of the lower end of the humerus may lead to long-continued disability or even permanent disability of the hand because of ischæmic paralysis, or Volkmann's contracture; or because of ankylosis of the fingers which has been caused by the persistent swelling of the hand. A proper reduction of the fracture before the first dressing will eliminate any danger of such untoward results. To dress the elbow in acute flexion without complete reduction of the fragments tends to produce a constriction of the vessels at the elbow, which may cause a Volkmann's contracture, or fibrous ankylosis of the joints of the hand.

He had seen cases of fracture of the upper end of the humerus or dislocations of the shoulder produce a long-continued disability of the hand which was due to this same fibrous ankylosis of the joints of the fingers. In practically all of these cases can be obtained a history that the hand remained swollen for a period of weeks during the treatment of the fracture or dislocation. One cannot emphasize too strongly the

necessity of watching carefully for circulatory disturbances, for such disturbances usually indicate an incomplete reduction of the fracture, or, less commonly, an improper dressing.

PAPILLARY CYSTADENOMA OF THE BREAST

DR. JOHN H. GIBBON reported two cases of papillary cystadenoma of the breast and exhibited the specimens. Both cases had been operated upon within a week. The first was that of a woman, sixty-five years of age, operated upon at the Jefferson Hospital, October 26, 1920. She had had ten children and two miscarriages. Mass in the breast first noticed ten years ago. Other masses developed and about two years ago one of them was incised by her physician and a quantity of blood and pus evacuated. The breast contained several masses, the largest about the size of an egg, covered by thin skin and evidently containing dark fluid. Translucency was present in the largest mass. The swellings were grouped around the centre of the breast, the nipple was contracted and considerable fibrous tissue could be felt between the tumors. The breast was freely movable but an enlarged gland could be palpated in the axilla. Through a Stewart incision the breast with the great pectoral muscle and all the axillary glands and fat was removed. The glandular involvement was much more extensive than he had expected. On opening one of the cysts it was found to be filled with bloody fluid and at one point there was marked papillary outgrowth. A part of the cyst wall was calcareous. Microscopic diagnosis in this case was "papillary cystic adenocarcinoma of mamma with metastasis to the axillary lymph-nodes."

The second case was that of a woman forty years of age, operated upon at the Pennsylvania Hospital, October 27, 1920. This patient had never been pregnant. Had noticed a tumor in the left breast for six or seven years. It remained quiescent until about six months ago, since when it has progressively increased in size. Examination showed a multilocular, freely movable, fluctuating tumor in the outer and lower quadrant of the left breast. No glandular enlargement was detected. Through a Stewart incision the breast, with the sheath of the pectoral muscle and the axillary glands and fat, was removed. On opening one of the cysts, which presented on the posterior surface of the gland, it was found to be filled with a papillary outgrowth. Thinking that the condition was probably malignant, the great pectoral muscle was then removed and a more complete dissection of the axillary glands and fat made. The microscopic diagnosis in this case was "papillary intracystic fibro-adenoma." The lymph-glands in this case showed no evidence of metastasis.

The incidence of papillary cystadenoma of the far-advanced type represented in the cases shown is rather rare nowadays, because all cases of tumor of the breast are receiving much earlier treatment. The condition has been described by many writers under many names. It is the hydatid disease of Sir Astley Cooper, the serocystic sarcoma of

Brodie, the cystosarcoma phylloides of Müller, and the proliferous cyst of Paget. Paget's description of the condition in his "Lectures on Pathology," 1853, is a most complete one, and he describes the clinical course of the disease in a very thorough manner.

During the past ten years the reporter had operated upon six cases of papillary cystadenoma and twenty-eight of fibrocystadenoma, which shows that the condition is not very rare. Of course, during this same period the cases of subinvolution-cysts of the breasts have been much more numerous than the two other types combined.

The classification of these cases has always been confusing because of the association of the fibrous and epithelial elements in the tumors. Collins Warren, however, in his "Surgical Oration" before the A. M. A., in Portland, 1905, clarified the difficulty by proposing the two terms, fibrocystadenoma and papillary cystadenoma. He reported twelve cases of the latter condition from the Massachusetts General Hospital and his own practice.

This disease is seen in women usually past forty-five and who have borne a great many children. The tumors grow slowly for years and are then apt to take on rapid growth. Rupture by ulceration took place quite frequently in the cases reported fifty years ago, and the growth taking on a fungoid character was considered sarcoma.

The skin in the later stages becomes thin, the cysts stand up prominently and are often translucent, as in one of the cases here reported. The tumors usually form about the nipple and much fibrous tissue can be felt between them. Fluctuation is distinct. Glandular involvement is rare. Paget reports a case in which there was glandular metastasis and recurrence, and in one of the speaker's own cases malignant glandular involvement was present. Bleeding from the nipple is considered one of the common symptoms, but it was present in neither of the cases, specimens of which he was exhibiting.

Clinically the condition must be looked upon as malignant, although in its early stages it is only mildly so. The differentiation from fibrocystadenoma, or what is commonly called cystic adenoma, can be made by macroscopic inspection of the cyst wall, which in the one case is smooth and in the other contains papillary outgrowth.

The treatment of this condition, of course, is amputation of the breast together with the removal of the axillary glands and fat, as it is impossible to tell whether or not an epitheliomatous change has occurred. He did not think that the absence of palpable glands in these cases is sufficient to justify one in omitting the dissection of the axilla.

RATIONAL TREATMENT OF FRACTURES OF THE TUBULAR BONES

DR. JOHN B. ROBERTS said that a gratifying sequel of the European war has been to dispel the delusion that a great group of closed fractures of the long bones must be subjected to adjustment of fragments by blood-spilling operations; as a consequence, the ability to obtain good results in such fractures, without resort to incisions for inspecting and fixing frag-

ments, has been secured by many medical men. Thus the former craze for operative reduction has been much lessened. The treatment of open, contaminated and infected fractures, moreover, has been greatly improved by the investigation and experience of military surgeons. A rational study by the inductive method seems to him to establish these propositions:

The majority of closed fractures of long bones may be cured with good function and good anatomical result without exposing the bone by operation. Some open fractures of these bones, if kept aseptic, may be properly cured without exposing the bone by operation.

A moderate proportion of closed fractures only will need operative exposure of bone, to correct malposition of fragments; and some of these should have direct fixation.

Many open fractures, especially gunshot injuries, will require operation to convert contaminated fractures into aseptic fractures, and to permit primary closure of the wounds. Some of these open fractures will also need readjustment of fragments and possibly direct fixation of fragments.

Conversion of contaminated fractures into aseptic fractures should be done within the first eight or ten hours by removal of foreign bodies, excision of debatable soft parts and perhaps of the small fragments; whenever practicable, the wound then should be closed by primary suture and the bones given external rigid support.

Closed fractures needing exposure of bone for readjustment of fragments probably do better, in respect of freedom from sepsis, if operated upon about seven days after injury.

Comminution of bone in closed fractures does not add much to the severity of the injury, but it requires that the external support and the accuracy of coaptation receive vigilant attention.

Comminuted open fractures, if kept aseptic or early rendered aseptic, do well, because the small fragments may furnish many centres of callus deposition.

Nearly all closed fractures and many open ones of the upper limb may be successfully treated as to functional ability and anatomical integrity by means of ambulatory dressings.

Nearly all fractures of the lower extremity, whether open or closed, do better when treated in bed with suspension of the limb and more or less continuous traction. An exception to the rule of treating fractures of the lower limb in bed may be made in fractures of the fibula and of bones of the foot.

Most fractures of the femur, and a considerable number of the tibia, must have strong traction added to suspension of the external fixation apparatus.

A few fractures of the upper limb, closed and open, require suspension with traction. This is particularly true in fractures of the upper end of the humerus, and is more frequently needed for infected fractures in this site.

Fixation by external splinting is best given to the upper limb by using the thorax as a splint for the humerus; some form of plastic material moulded to the surface is usually best for the bones of the forearm. Encircling the arm or forearm is dangerous in the early stages of the treatment; it is liable to cause ischæmic myositis or gangrene.

When suspension and traction are required for upper limb fractures the patient should be kept in bed for a time; and external splinting should usually be obtained by steel rods used in similar form to the braces and splints advised in fractures of the lower limb or by a modified Buck's traction apparatus.

The suspension and traction so valuable in fractures of the femur may best be obtained by the N. R. Smith or Hodgen anterior heavy wire splint, the modified Thomas splint, or by traction with the Buck's extension method, with or without suspension, or by adoption of the Bradford frame. The Thomas splint is probably the best of these methods in adults with great overriding of the fragments. It is particularly valuable if the patient must be subjected to transportation.

The joints, muscles and skin in fracture cases should be given attention from beginning to end of treatment, if the best results are to be obtained.

Joints should not be kept immobile longer than one or two days. Careful passive and active movements usually should be allowed within the first few days, and frequently repeated during the course of the treatment.

It is a common practice to permit weight bearing on fractures of the lower extremity too soon. Secondary deformity is frequently caused by this error. Crutches and braces and other devices should be used to prevent such deformities.

No special form of splint or apparatus can be substituted with safety for that knowledge of anatomy, pathology and mechanical intelligence which constitutes a surgical grasp of the particular fracture needing professional care.

DR. JOHN H. GIBBON remarked upon the change that has taken place in the last five years regarding the treatment of fractures. A question of the utmost importance mentioned by Doctor Roberts is that of mobilization. Movement, both passive and active, is that which is most needed to-day in the treatment of fractures in civil life. In fractures of the thigh he had taken out more plates than he had put on. He recently saw the case of a boy operated on eight years ago for fracture of the thigh; it was plated with a good result. The boy suffered a refracture three weeks ago at the site of the last screw. Traction to overcome the deformity was unsuccessful. There was nothing to do but to operate, and he found a lot of blood serum, with pus, around the plate. There was no fever. He took away the plate, but could get only partial reduction. The wound was closed without drainage. This was three weeks ago. There is a good deal of union at this time.

BOOK REVIEWS

- I. DES ANDREAS VESALIUS SECHS ANATOMISCHE TAFELN vom Jahre 1538 in Lichtdruck. Neu herausgegeben und der 86 Versammlung Deutscher Naturforscher und Aertze zur Feier die 400 Wiederkehr des Jahres seiner Geburt, dargeboten von MORIZ HOLL (Graz) und KARL SUDHOFF (Leipzig). 1920. Verlag von Johann Ambrosius Barth in Leipzig. Boards, folio, tafeln 6.
- II. HISTORY AND BIBLIOGRAPHY OF ANATOMIC ILLUSTRATION in its relation to Anatomic Science and the Graphic Arts by LUDWIG CHOULANT. Translated and edited with notes and a biography by MORTIMER FRANK, B.S., M.D., of Chicago, with a biographical sketch of the translator and two additional sections by FIELDING H. GARRISON, M.D., and EDWARD C. STREETER, M.D. 1920. The University of Chicago Press, Chicago. Cloth, royal 8vo., pp. 435.
- III. THE SCHOOL OF SALERNUM (Regimen Sanitatis Salernitanum). The English version by SIR JOHN HARINGTON. History of the School of Salernum by FRANCIS R. PACKARD, M.D., and a Note on the Prehistory of the Regimen Sanitatis by FIELDING H. GARRISON, M.D. 1920. Paul B. Hoeber, New York. Cloth, 12mo., pp. 216.

The appearance of these books simultaneously upon the reviewer's table indicates a growing interest in the history of medicine and in medical bibliography. The influence of Billings, the creator of the magnificent collection of medical books constituting the Library of the Surgeon General's Office of the United States Army, the magnetic persuasions of Osler, the traditions of George Jackson Fisher, the bibliophilic country physician of Sing Sing, the example of Oliver Wendell Holmes and his gifts to the Boston Medical Library, the growing alcoves devoted to such books in the great medical libraries of New York, Brooklyn, Philadelphia and Baltimore, the publications of the Charaka Club which give an occasional hint of the transactions of that select organization, the "Annals of Medical History" edited by Packard and published by Hoeber, both of them antiquarian enthusiasts, the recent volumes on the "History of Medicine" by Buck and by Garrison, these together with numerous other notable influences have combined to give much impetus to the antiquarian cult among American medical men of late years. May it not be said also that it is both a sign and a result of a higher scholarship prevailing among the American profession? This interest in medical history has been accentuated also by the occurrence in 1914 of the four hundredth anniversary of the birth of the great anatomist, Vesalius, which obtained widespread observance in this country as well as in Europe.

In Germany the Society of Naturalists and Physicians at its Congress held in the spring of 1914 undertook in celebration of this Vesalian anni-

versary the issual of a facsimile reprint of the famous six first anatomical plates which were published by Vesalius in 1538, as a preliminary proof and sample of the work in which he was engaged, which five years later, in the full magnificence of its completed form, burst upon the world in his "De Humani Corporis Fabrica" published in Basel by the printer Oporinus in 1543. The carrying out of this most praiseworthy plan of the German society was interfered with by the outbreak of the World War in the early summer of that year, but with the return of peace the project has been taken up anew with the result that this most interesting and valuable atlas is now in our hands, giving to every scholar the opportunity of becoming, by the outlay of sixty marks, the owner of a facsimile copy of what is one of the rarest medical *Preciosa*.

II. Ever since its publication in 1852 the work of Choulant, "Geschichte und Bibliographie der Anatomischen Abbildung," has been sought for as the final authority on all matters pertaining to the development of the use of graphic means for representing human anatomy, and as an inexhaustible mine of information on the subject. The German original has long been out of print, though occasional copies may have been procurable from the dealers in antiquarian medical books. One of the evidences of the increase of interest in medical history and bibliography, mentioned above, is to be found in the project of one of the younger medical enthusiasts of Chicago to translate Choulant's book into English and make it, with attractive and important additions, accessible to the medical profession of to-day. He had finished the task and turned the manuscript over to the publishers when he was overtaken by an untimely death, April 21, 1919. Through the interest of his professional friends the publication of the book was not permitted to be delayed, but rather hastened as a fitting memorial of Doctor Frank himself. The book is now before us. For many years we have been the fortunate possessor of a copy of the original and are delighted to be able to place by its side on the library shelf this copy in English with its important addenda. Frank has made it a much more *readable* book by simplifying its involved sentences and rendering them into clear, crisp English. To the original Frank has added accounts of the later researches made by Sudhoff and others among mediæval manuscripts. There are also supplementary sections on Sculpture and Painting as Modes of Anatomic Illustration, and Anatomic Illustration Since the Time of Choulant. The reader will be greatly attracted by the excellent portrait of Choulant which faces the title page. We wish that the memorial notice of Doctor Frank, from the pen of Garrison, might also have been accompanied by a portrait. The book is sure to meet with a wide and continued demand. New methods of book illustration have come into use—the facility with which recent reproducing processes make it possible to multiply photographic prints have fairly swamped the medical books of the present day with half-tone plates. Color lithography has made the free diffusion of colored plates

easy; nevertheless, the glorious plates that illustrated the work of the anatomists from the time of von Calcar to that of Daguerre, will always remain of profound interest to the physician who is interested in the development of the science and art of medicine, while the crude attempts of the pre-Vesalian period will equally engage his attention as the early glimmerings of the dawn of a new day for medicine.

III. The *Regimen Sanitatis Salernitanum* enjoys a perennial youth. There are eighty odd mss. copies of it known to be extant, dating back to the years before the invention of printing, while Hough enumerates forty-seven editions of all kinds printed between the years 1474 and 1500. Sudhoff, indeed, traces its origin to a prose hygienic epistle (*De conservatione corporis humani*) supposed to have been written by Aristotle for the benefit of his pupil Alexander (the Great) which prose epistle bears a striking resemblance to the versified specimens of the "*Regimen sanitatis*" which latter began to appear in the twelfth century, in response to the demand for codes of hygienic rules for all the phases of life which seems to have become prevalent at that period. Packard, however, pronounces this Aristotle and Alexander combination to have been a fake, a mere Arabic business device, to give "go" to the product of a mediæval brain. The first English translation was published in 1530 by Thomas Paynel. In 1608 another English version appeared, attributed to Sir John Harington, of which this most recent of editions is a reprint. Dr. Francis Packard has prefaced the text of the "*Regimen*" with an interesting history of the School of Salerno, to which is added by Dr. Fielding Garrison a note on the Prehistory of the *Regimen Sanitatis*. Opposite the title page is a portrait of Harington. The typographical setting of the book is most attractive and is worthy of its subject. It makes a very excellent companion to the edition of the "*Gold Headed Cane*" previously issued by the same publisher.

LEWIS S. PILCHER.

THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM. An Introduction to the Study of Nervous Diseases. By FREDERICK TILNEY, M.D., Ph.D., Professor of Neurology, Columbia University, and HENRY ALSOP RILEY, A.M., M.D., Associate in Neurology, Columbia University. Octavo, cloth, pp. 1020. New York. Paul B. Hoeber, 1921.

This volume, a credit to clinical neurology and an ornament to the Anatomy Department of Columbia University, is the result of years of earnest work and study. Nearly every page testifies that the authors have not spared themselves, either in examining the literature or studying specimens for the purpose of getting a deeper understanding of the form and functions of the central nervous system. Heretofore no single work has provided a clinical and physiological interpretation of the brain and spinal cord suitable to practical requirements. The authors' aim in this book is set forth in the introductory chapter as follows: "This work is designed to fill the gap between

morphology and the practical requirements of clinical medicine. It aims to visualize the living nervous system, to make accessible an appreciation of its vital relations to the functions which go to make up life, as well as the defects in these relations which result in disease."

In reality the book covers five subjects: Embryology, Anatomy and Histology, Physiology, Pathology and Clinical Neurology, all blended into a harmonious whole. The result is that the student gets a clear interpretation and analysis of clinical neurology. The early chapters deal with the Embryological Development of the Central Nervous System. This contains a résumé of the former work of importance and some new and original investigation and many excellent illustrations. The Structural Unit of the Nervous System is next studied. It deals minutely with the histology and physiology of the nerve-cell and its processes. The different forms and functions of nerve-cells are described in detail and illustrated clearly. The neuron theory is supported. The Central Nervous System is then taken up, the Spinal Cord, Medulla, Pons, Cerebellum, Midbrain, Interbrain and Endbrain are studied successively. The same scheme is followed throughout in the presentation of each division of the central nervous system. First its general character and anatomy, followed by histology and physiology, and finally its principal syndromes which are presented by actual case histories. An anatomical interpretation and analysis is made of each case.

The entire study of the spinal cord and several divisions of the brain is so interesting, it is difficult to say which should receive the greatest commendation. Especial mention should be made of the chapters devoted to the cerebellum. The authors have contributed as much to our knowledge of the cerebellum as have any recent workers. Much may be found in these chapters which does not appear in any other text. Many new contributions on the functions of the thalamus and its divisions and also the Corpus Striatum may be found. In addition to their own original work they have drawn extensively on recent investigations of other authorities on the thalamus and basal ganglia.

The book as a whole is systematically arranged and logically presented. Each division of the central nervous system is studied minutely, yet concisely set forth. It is apparent that the text is best suited for students of neurology, but it should be a valuable addition to the library of any one interested in clinical medicine.

L. BEVERLEY CHANEY.

EDITORIAL COMMENT

Since July, 1903, the *ANNALS OF SURGERY* has borne upon its title page as one of its Editorial Collaborators the name of William Watson Cheyne. During all the years that have since elapsed this collaboration of Mr. Cheyne, now Sir W. Watson Cheyne, has been continued with great advantage to the *ANNALS OF SURGERY* and to the sincere gratification of its editor. It is therefore with much regret that he has received a recent letter from Sir Watson containing the information that on account of ill health he has definitively retired from active professional work and asks that some other name be substituted for his as the London Collaborator for the *ANNALS OF SURGERY*.

Of course, such a request is a command and has been reluctantly complied with. We take this occasion to express our deep appreciation of the many services which Sir Watson has rendered to the *ANNALS* during these eighteen years and to express the wish that in his retirement from active labor he may find a renewal of health, and that many years yet of useful and happy life may be reserved for him.

The vacancy thus created has been filled by Mr. W. H. Clayton Greene, Surgeon to St. Mary's Hospital of London, whose name appears on the title page of this issue of *ANNALS OF SURGERY*.

LEWIS S. PILCHER.

"FRAZIER ON SURGERY OF THE SPINE AND SPINAL CORD."

In the review of this book in the *ANNALS OF SURGERY* for January, page 138, the name of the publisher was inadvertently omitted. It should have been D. Appleton and Company, New York.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

ANNALS *of* SURGERY

VOL. LXXIII

APRIL, 1921

No. 4.

PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS*

BY EUGENE H. POOL, M.D.

OF NEW YORK, N. Y.

ATTENDING SURGEON TO THE NEW YORK HOSPITAL

THIS paper is based largely upon a case of suppurative pericarditis which was observed on the Second Surgical Division of the New York Hospital. It illustrates certain principles of treatment which I wish to emphasize, notably the technic of pericardiotomy and the post-operative treatment by the Carrel-Dakin method.

Suppurative pericarditis is not an excessively rare lesion, although operations for its relief are relatively infrequent. Stone found purulent pericarditis in 14.5 per cent. of 300 patients who had died of pneumonia. None of the forty-four cases had been operated upon. Stone's figures, however, are much higher than those of most observers. The variance in the statistics is due to the fact that the incidence of this complication of pneumonia varies greatly in different epidemics and in different years. The lesion may also develop secondarily to other infections besides pneumonia; may occur primarily, and may follow infection from without through a wound. A considerable proportion of the cases occur in children (Gill). The diagnosis of pericardial effusions, according to Stone, should offer little difficulty when the amount reaches 300-500 c.c. Yet, Osler states that "probably no serious disease is so frequently overlooked by the practitioner." The explanation is that the condition is frequently not thought of and its signs not sought. If there is doubt as to the purulent character of the exudate, this is readily demonstrated by paracentesis.

Because the involvement of the pericardium is usually secondary in the course of a general sepsis, and often constitutes a terminal infection, medical men have not been inclined to refer these cases to the surgeon. As a result, operations in general have not been undertaken sufficiently early nor often. Although the prognosis is extremely grave in such secondary infections of the pericardium, it is not necessarily hopeless, as has been repeatedly demonstrated by the recovery of apparently moribund patients.

* Read at meeting of New York and Philadelphia Surgical Societies, December 8, 1920.

The report of the case is as follows:

The patient was a boy of nine years who had always been robust and healthy until the present illness. About nineteen days before admission he had a violent chill followed by cough and vomiting. On the following day the condition was recognized as pneumonia involving the right lung. Three days later the left lung also became involved. The temperature ran between 104° and 105° , and the patient became delirious. Three days before admission to the hospital, the attending physician suspected suppurative pericarditis. Dr. E. Cussler, who was called in consultation, concurred in the diagnosis and referred the patient to the New York Hospital.

Physical Examination (on admission).—The boy was emaciated, flushed, dyspnoic and evidently acutely ill. Temperature, 103° ; pulse, 120; respiration, 48.

Chest. The expansion was limited on both sides; the excursions shallow and rapid. Fremitus was decreased in the right mid-axilla down to the base. Percussion was slightly hyper-resonant throughout, except in right chest from anterior axillary line to the outer border of the scapula. This area was dull. Breath sounds in this area were almost absent. Throughout the remainder of the chest the breath sounds were harsh and high pitched with numerous moist râles most marked over the upper right lobe anteriorly.

Heart. The apex impulse was absent; percussion showed enlargement both to the right and left; no murmurs or accentuation were noted. At the base there was heard a slight pleuro-pericardial friction sound. All sounds were very distant and muffled.

PERCUSSION OF HEART

Space	To Right	To Left of Midline
2nd	1 cm.	2 cm.
3rd	2 cm.	4 cm.
4th	2 cm.	6 cm.
5th		9 cm.
6th		10 cm.

Extremities—No œdema. *Blood*—Red blood-cells, 4,640,000; hæmoglobin, 88 per cent.; white blood-cells, 19,800; polymorphonuclears, 90 per cent. *Urine*—10.25-acid-albumin trace, granular casts. X-rays showed pericardial effusion with sacculated fluid in external part of right chest (*cf.* Fig. 1).

Operation (April 6, 1920).—Pericardiotomy and right thoracotomy for empyema. Ethyl chloride ether anæsthesia.

The pericardium was aspirated just mesial to the outer margin of dulness in sixth space and pus obtained. Curved incision from fifth rib at left border of sternum down to seventh rib, then curving outward along seventh, in all about three inches. The flap thus formed was lifted outward from the bony structures and about one and one-half inches of the costal cartilages of the sixth and seventh ribs were removed. The internal mammary was ligated above and below. The triangularis sterni was cut and the pericardium exposed. Two per cent. novocaine was injected in the pericardial

and the pericardium opened vertically about one-half inch from the sternum. On opening the pericardium a large quantity of thick pus exuded. This was allowed to escape slowly; then the opening was enlarged. A finger introduced revealed a considerable amount of thick fibrin. This loosely bound the heart to the parietal pericardium. It was freed with the finger, and masses of it were removed with forceps. Pericardium on each side was then sutured to the superficial soft parts and a small tube and a rolled rubber dam introduced.

Needle was introduced in midaxillary line, right side, sixth interspace, and thick pus obtained. Thoracotomy in intercostal

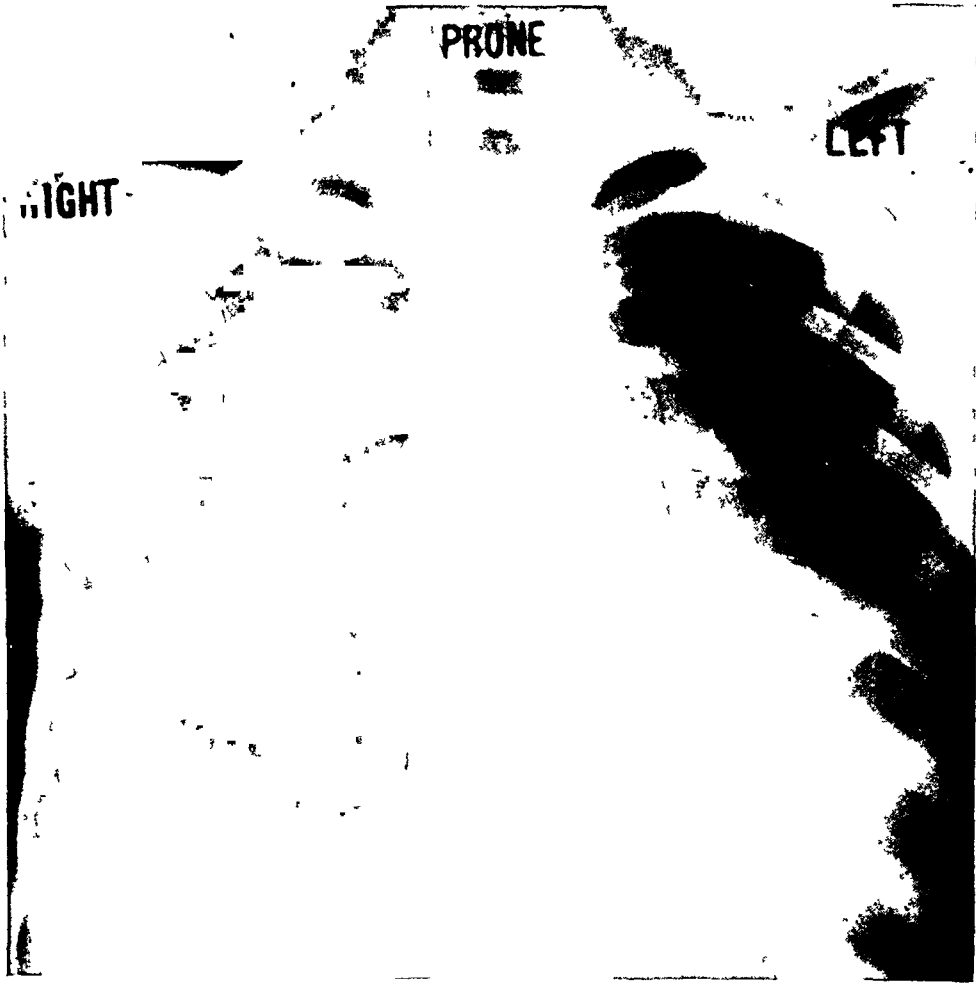


FIG. 1.—On admission.

space and large drainage tube introduced with Auchincloss apparatus attached. A rapid intercostal thoracotomy for empyema was performed without the evacuation of fluid at the time in order to diminish shock.

Post-operative Course (abstract of notes).—April 8th, second day, drains removed and two Carrel tubes, open at ends and without lateral perforations, inserted to depth of wound, about five inches. Dakin's solution was introduced very slowly by gravity; 10 c.c. every hour through each tube. The wound was dressed daily, following the Carrel technic, tubes being removed and fresh tubes reinserted.

By means of a back rest the boy was kept in a sitting position most of the time.

April 9th. General condition very good. At dressing patient was lifted and turned. Only about six drops of thick, yellow pus escaped.

April 11th, fifth day, empyema tube removed for first time, little

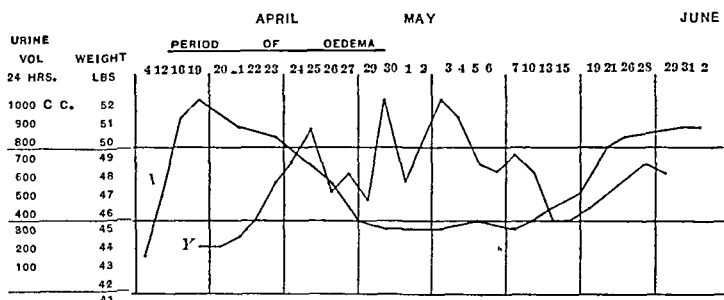


FIG 2 —Chart showing relation between weight and urine during and after oedema Line y indicates urine c c twenty-four hours Line a indicates weight

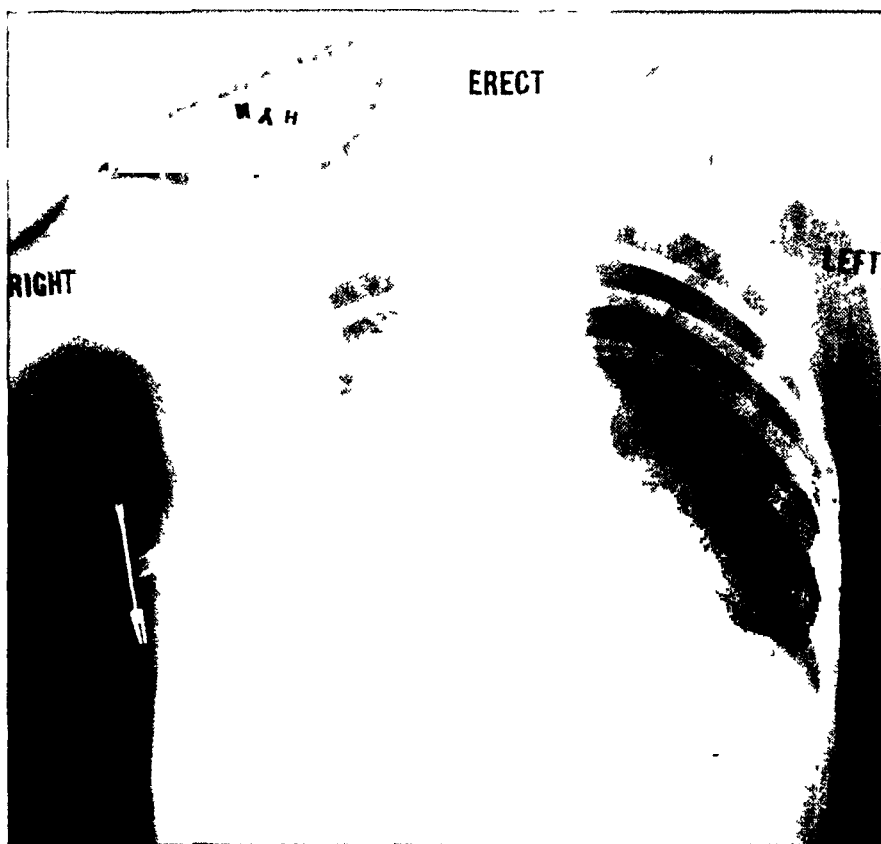


FIG 3 —One month after admission

pus and small cavity. Large tube reintroduced and through it Carrel tube inserted. Ten c.c. of Dakin solution introduced thereafter every hour.

Pericardial wound. Discharge now thin and mucoid, not purulent. Only one Carrel tube introduced.

April 16th. Moderate discharge from pericardium. Abdomen distended. Œdema of face, scrotum, legs and abdomen. Patient's weight increased and urine excretion was low (*cf.* Fig. 2). Urine showed trace of albumin and few granular casts. Tincture digitalis was administered, M 140 in five days. Turned on face to allow fluid to gravitate from pericardium, little escaped. Scant discharge from empyema. X-ray showed thickened pleura on right side. Heart shadow still enlarged to left. During the first ten days temperature fluctuated from 100° to 104.6° . From this time, with one exception, it did not exceed 101° .

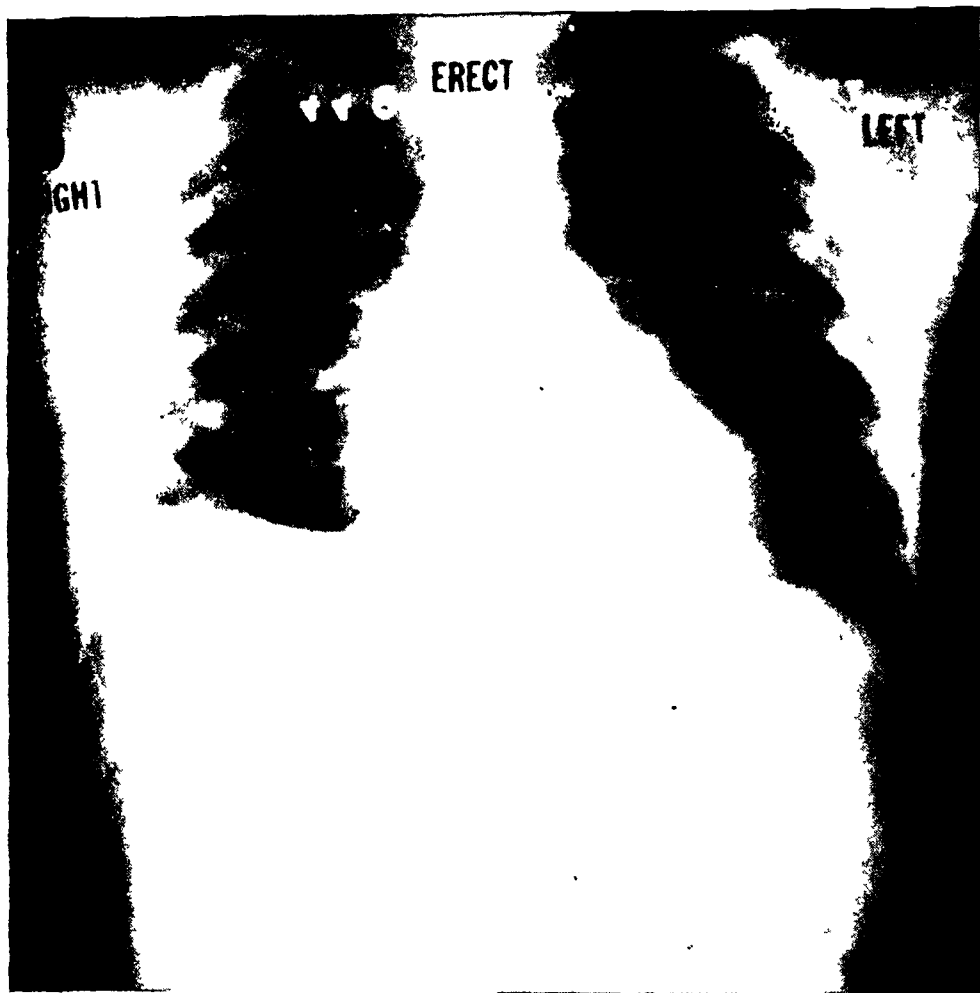


FIG. 4.—Two months after operation.

April 20th. Patient's general appearance improved. Temperature, 99.4° . Pulse of good quality. Not dyspnoëic. Œdema of face and legs less.

April 23rd. Condition improved. Discharge less. Turned on face, practically no discharge. Œdema of abdomen and scrotum less. With the clinical improvement the weight diminished and the urine increased.

April 30th. General condition markedly improved. Small irrigation catheter passes inward four inches. Cavity held only about 2 c.c. Marked pulsation of whole precordial region. Œdema practically gone. It was believed that the œdema was due to myocarditis.

May 4th. Very little discharge from wounds. General condition improving.

May 11th. Tube shortened gradually from this time about one-quarter inch every two to three days. X-ray showed thickened pleura and pleuro-pericardial adhesions on right side. Some infiltration of right lung (Fig. 3).

May 25th. Pericardial wound very slight discharge. Tube reinserted.

May 28th. Empyema wound, no drainage. Pericardial wound practically no drainage. Drain removed. Condition good.

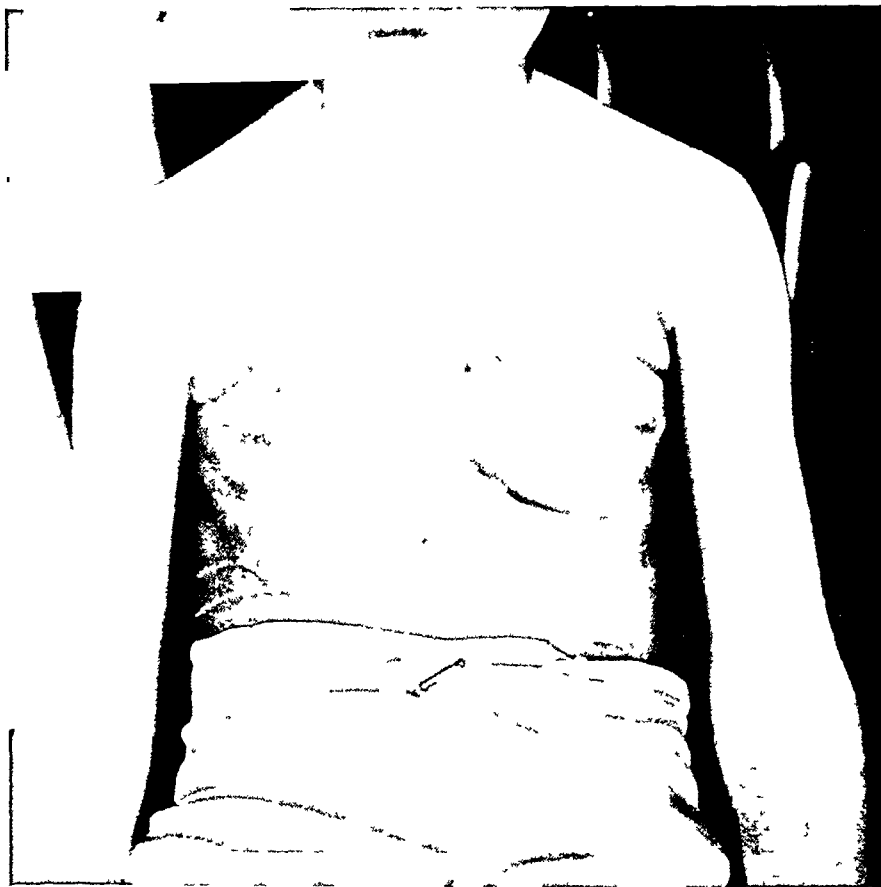


FIG. 5.—Patient on discharge June 4, 1920, two months after operation.

June 1st. X-ray showed thickened pleura, lower right (Fig. 4).

June 2nd. Examination by Dr. W. R. Williams. Mesial part of precordial scar retracted in systole. Cardiac dulness extends 2 cm. to right of midline in fourth and fifth spaces. To the left 3 cm. in second; 5 cm. in third; 9 cm. in fifth space. Heart action regular and of good quality; no thrills nor murmurs. On breathing expansion of both sides of chest good. Empyema scar at level of eighth rib; opposite this level, both in front and in back, resonance is diminished, as are also fremitus, breathing and voice. Over rest of lungs signs are normal. No râles heard at any point.

June 4th. Discharged from hospital. General condition excellent (Fig. 5).

On October 19, 1920, Doctor Williams reported as follows: On inspection left side of chest bulges little more than right. Apex impulse definite in fifth space 8 cm. to left of midline. No retraction of chest wall with systole.

Cardiac dulness extends 3 cm. to right and 8 cm. to left of midline. Apex impulse is felt in the fifth space 8 cm. to left of midline. P-2 is greater than A-2. No murmurs heard. Rate 92, regular, sounds have good muscular quality.

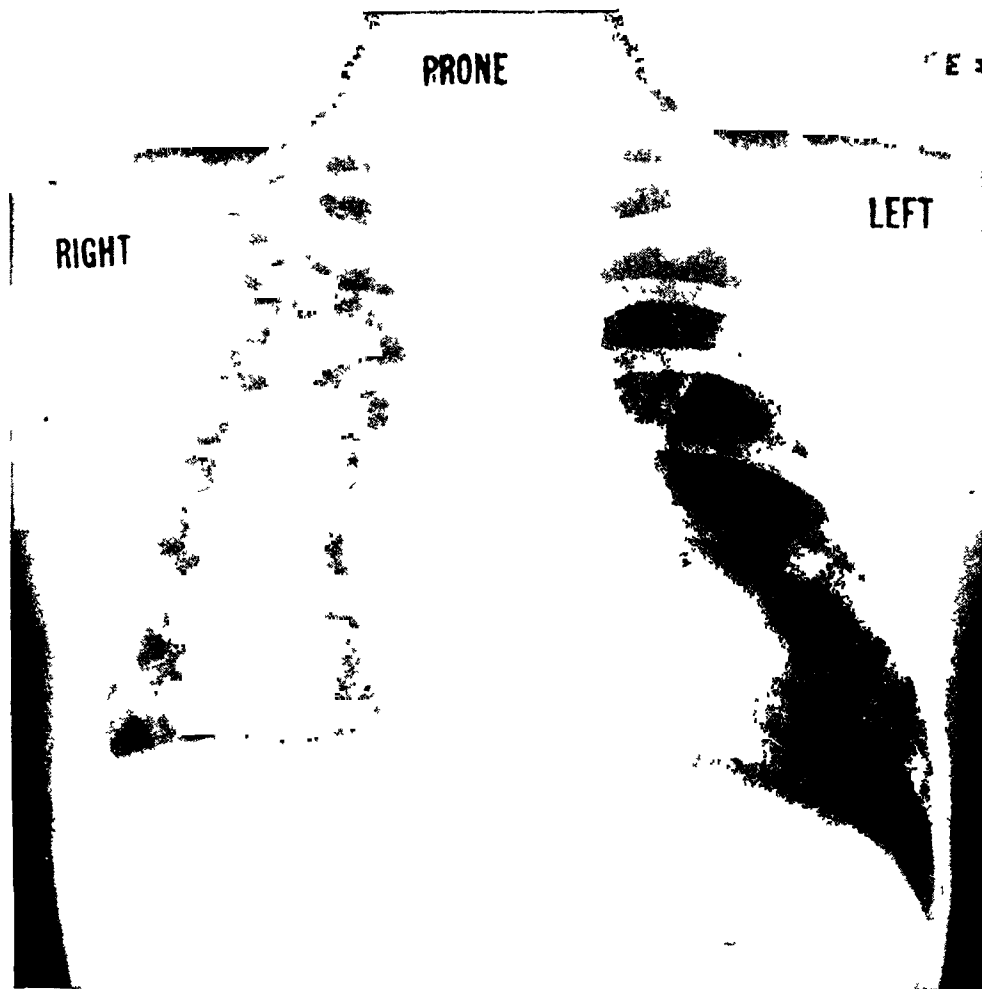


FIG. 6—Six months after operation

Fluoroscopic Examination.—Movements of diaphragm normal—no evidence of pleural adhesions. The heart shadow somewhat more horizontal than usual; transverse diameter of the shadow was 11 cm. No systolic retraction of any ribs or costal cartilages could be seen (Fig. 6).

Electrocardiographic Report (Dr. Harold Pardee, Fig. 7).—The tracing of May 6th, taken when the pericardium was open and draining, shows the presence of a slight degree of right ventricular predominance. The "T" wave is turned downward in all three leads which indicates that the myocardium is abnormal. The "T" wave also shows a curious upward curve in lead I between the "S" wave

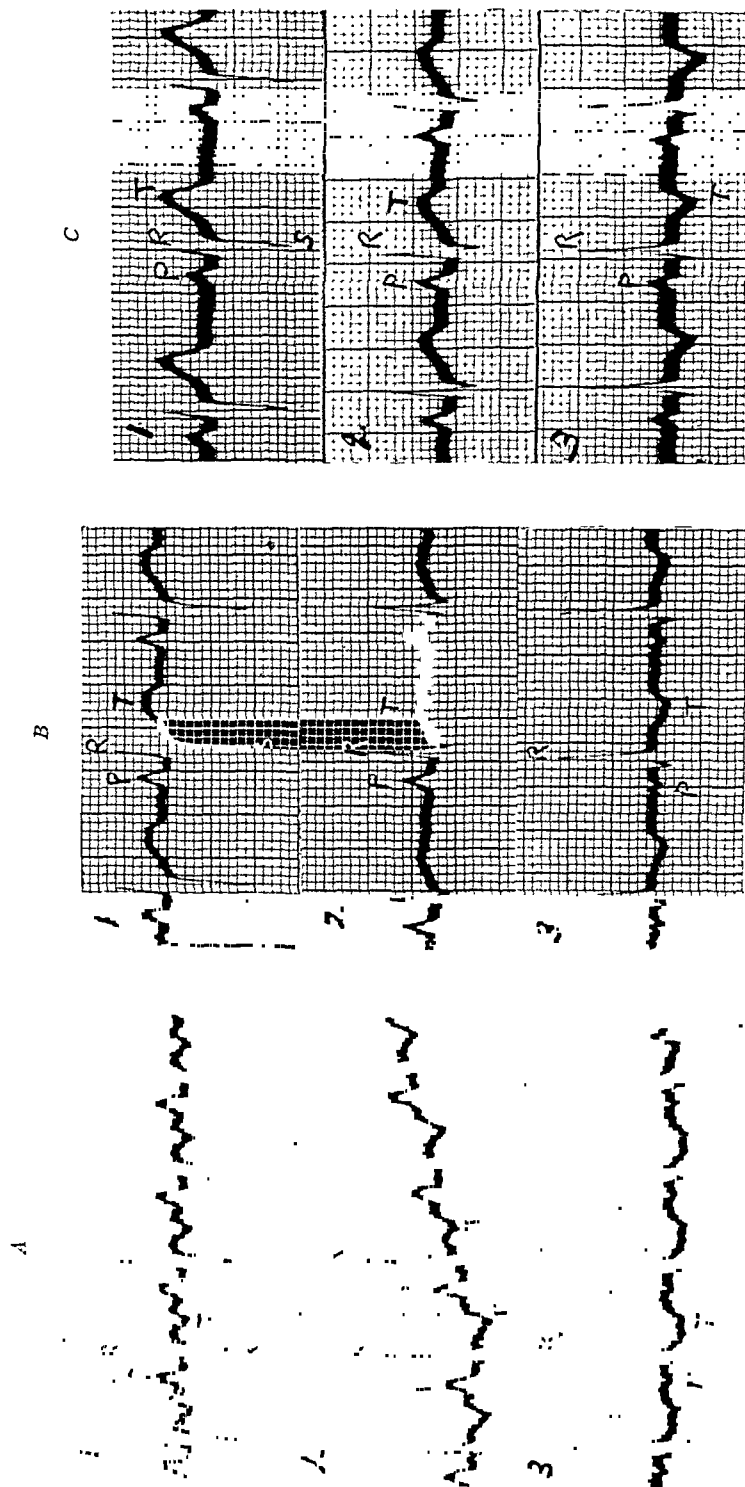


FIG. 7.—Electrocardiograms taken on three different occasions. In each record the curves are by leads 1, 2 and 3 from above downward. The vertical lines represent time and are 0.4 second apart—one-fifth of a second between every fifth line. Movements of the curve across the horizontal lines are due to variations in the amount of the heart's current, the space between ten abscissae representing one millivolt. Record A: May 6, 1920. Record B: June 11, 1920. Record C: October 18, 1920.

and the downward peak of the "T" wave, which is often found when the myocardium is the seat of a focal process. The auricular waves are normal and the "P"-"R" interval is normal, showing that there is no disturbance of the conduction system between the auricles and ventricles.

The record of June 11th, taken when the wound was closed and the patient up and about, shows a more normal-appearing electrocardiogram. The right predominance is still present and is more marked, but the "T" wave does not show the abnormal direction which it did in the previous record. This is probably due to an improvement in the myocardial condition which was previously present.

The record of October 18th shows very little change from that of June 11th, except that the right ventricular predominance is still more marked. This increase of the right ventricular predominance is probably due to the mechanical difficulty which this ventricle meets in contracting; possibly as the result of adhesions.

Summary of bacteriologic examinations made by Doctor Wheeler. The first cultures in this case were made at the time of operation on April 6th. Specimens of pus from pericardium and from pleural cavity were placed in tubes of broth, from which blood agar plates were inoculated. A pure culture of pneumococcus, Group IV, was obtained from the pericardial pus; the culture of pus from the pleural cavity remained sterile ten days. The pneumococcus, Group IV, isolated from the pericardium showed characteristic colonies on blood agar plates, had a distinct capsule, was bile-soluble, fermented inulin and was not agglutinated by any of the three types of anti-pneumococcus immune serum.

On April 16th, ten days after operation, cultures of pus from pericardium showed a pure growth of streptococcus hæmolyticus. The hæmolysis produced was slight, but the organism grew typically in long chains, in broth, had no capsule, was not soluble in bile, and did not ferment inulin. No pneumococci were found in these cultures. Cultures of pus from pleural cavity showed a hæmolytic streptococcus similar to that just described and many colonies of staphylococcus aureus.

Repeated cultures of pleural and pericardial exudates made at intervals of one to five days always showed a typical hæmolytic streptococcus producing well-marked hæmolysis on blood agar plates. No pneumococci were found in any of these cultures. At times secondary invaders were present; staphylococcus albus, a non-motile, non-liquefying, gram-negative bacillus and a diphtheroid bacillus; but these disappeared subsequently and the final cultures showed in each instance a pure growth of streptococcus hæmolyticus.

When last seen in December, eight months after the operation, the boy was apparently in normal health and was able to exercise as before the operation without embarrassment. The two costal cartilages apparently had reformed except at junction with sternum, where a narrow cleft could be felt.

Technic of Pericardiotomy.—Numerous procedures have been recommended for drainage in suppurative pericarditis. They need not be reviewed in detail. Two features, however, have become generally accepted: first, that the approach and drainage should be to the left of the sternum, and second, that no procedure should be employed which does not drain the lowest part of the pericardium. Although patients have recovered after removal of fourth, fourth and fifth, and fifth cartilages and incisions through the fourth or fifth space, such methods of approach should not be elected, since they do not provide a direct tract beneath the heart to the deep recesses on each side of the inferior vena cava.

Methods which are planned to drain the dependent part of the pericardium include resection of the sixth cartilage (Voinitsch, Kocher);

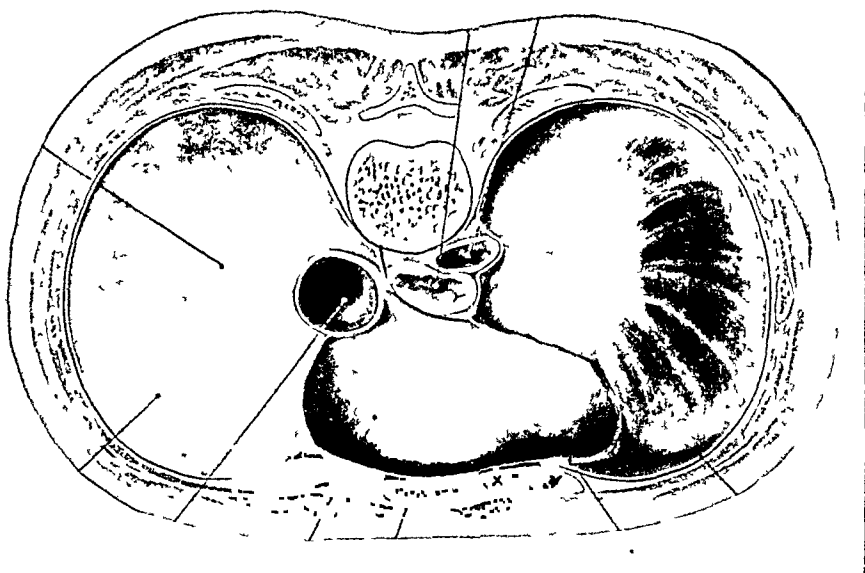


FIG 8 —Diaphragmatic portion of parietal pericardium X = seventh costal cartilage, Y = sixth costal cartilage (From Corning)

resection of the fifth and sixth cartilages (Delorme et Mignon); resection of the sixth and seventh cartilages with adjacent sternum (Voinitsch, Rehn); resection of the seventh (Mintz), and the epigastric route (Allingham). The epigastric or subcostal approach through the diaphragm is a rapid but rather blind procedure; moreover, it endangers the peritoneum and is very limited in extent, especially in adults (Cotts and Rowlands). Since this method cannot be recommended, the indications would appear to demand some procedure by which drainage is secured through resection of one or more of the lower costal cartilages.

Resection of a single cartilage, preferably the sixth, is not adequate for prolonged drainage. The relatively narrow tract rapidly contracts. It cannot be kept open with a rigid tube, as in an empyema, on account of contact of the tube with the heart. If the case does not do well and a deep accumulation of pus is suspected, exploration and reintroduction

of drain is difficult and necessitates some traumatism to the heart. These disadvantages of the method were forcibly demonstrated in a personal experience. Accordingly, in the case here reported, it was decided to make a more extensive exposure. Resection of the fifth and sixth cartilages was considered but rejected be-

cause the drainage is not as low as possible, and resection of the sixth and seventh cartilages was elected. This procedure was a marked improvement, yet it did not give as free exposure as is desirable. An effort, therefore, was made to plan a more satisfactory operation which will give ample exposure and provide the essential dependent drainage; and with this object the anatomy of the parts was reviewed.

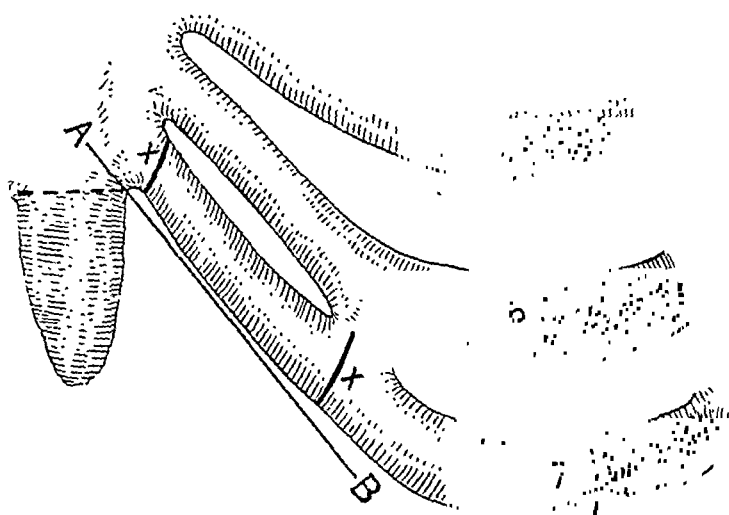


FIG. 9.—Mintz method, resection of seventh cartilage.

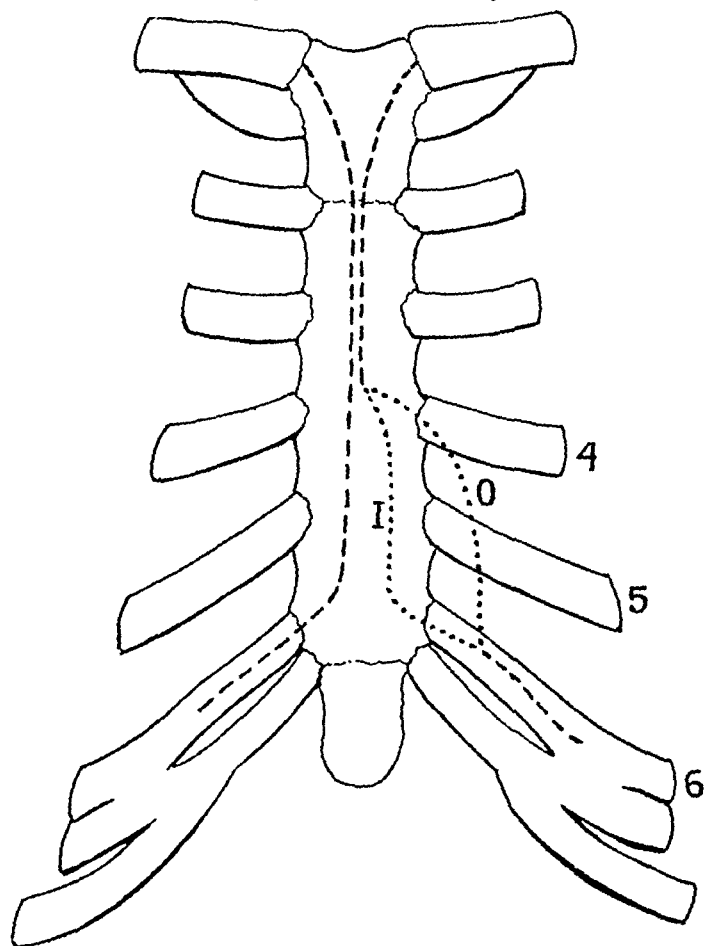


FIG. 10.—Reflection of pleura. On left side the anterior limits of pleura may lie anywhere between the dotted lines. The outer position (o) is the most frequent; the inner (i) the least frequent.

The relations of the heart and pericardium to the thoracic wall need not be outlined. Admirable descriptions are given by Moritz, Corning, and others. The diaphragmatic portion of the parietal pericardium, however, must be referred to, since it is along this surface that the drain should lie. Illustration shows relation of this surface to thoracic wall (Fig. 8). Since the sternal portion of the seventh cartilage is above the diaphragm and usually overlaps the pericardium, removal of this part of the cartilage is indicated to ensure dependent drainage. Mintz even limited his operation to resection of the seventh cartilage (Fig. 9).

The anterior reflection of the left pleura is relatively close to the sternum, yet varies somewhat. The limits most often noted are defined in the illustration (Fig. 10). With distention of the pericardium the reflection is said to be displaced slightly outward; moreover, adhesions may occur and close to some extent this part of the pleura by agglutination between its surfaces. However, reliance cannot be placed on these factors. It is obvious that a pericardial incision parallel to the ribs is

likely to open the pleura unless the incision be extremely short; while a vertical incision close to the sternum will usually safeguard the pleura. The first requisite, therefore, is that the pericardium be opened in a vertical direction close to the sternum.

Study of the bony thoracic structure shows that it is subject to wide variations, but the general arrangement as evidenced by dissections and illustrated in anatomies (Fig. 11) shows a close relationship between the sixth and seventh cartilages with little intervening space. Moreover, the fifth space is often narrow. Consequently, the removal of

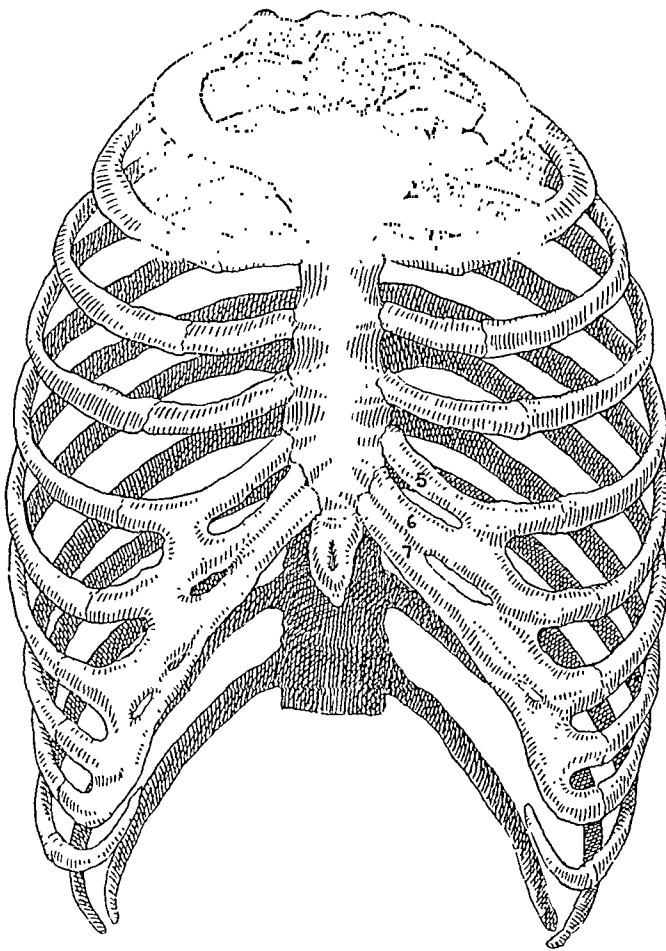


FIG. 11.—Bony structure of thorax. (From "Gray's Anatomy," Twentieth Edition, 1918, p. 116, Fig. 112.)

the sixth and seventh cartilages gives relatively little exposure in a vertical direction. The fourth space, on the other hand, is wide; consequently, the additional removal of the fifth cartilage adds greatly to the exposure in the vertical direction while it adds little to the severity of the operation. Therefore, if it is accepted that a vertical incision in the pericardium should be made, an adequate opening is best obtained by the removal of portions of the fifth, sixth, and seventh cartilages (Fig. 12). This allows approximately a two-inch incision in the adult as demonstrated on the cadaver.

Such a relatively extensive exposure has the additional advantage of favoring post-operative drainage. The importance of this factor cannot

be too strongly emphasized. As Ballance states, "In reading the records of cases of suppurative pericarditis, one is struck with the almost universal difficulty experienced in maintaining drainage." The situation of the exudate in the distended pericardium explains this (*cf.* Figs. 13 and 14). In a large proportion of cases pus accumulates after operation in the depths of the pericardium, especially in the left cul-de-sac. The heart descends over this pocket and the lung intrudes laterally, assisting in shutting it off. The drainage track may thus easily become blocked. Further, the incision through the soft parts tends to close with surprising rapidity as has been emphasized by Rhodes and others. With tract thus narrowed and blocked re-introduction of a drain or exploration of the depth of the wound is a difficult, dangerous, and blind procedure. A liberal exposure will tend to avoid these difficulties.

The following operative procedure is suggested. It is a modification of the method presented by Delorme and Mignon.

The incision (Fig. 15) begins at middle of sternum at level of the lower margin of fourth costal cartilage; curving it passes downward and to the left to upper margin of chondrosternal junction of fifth; then downward close to the left edge of sternum, crossing the fifth and sixth cartilages to the middle of the seventh cartilage; curving outward it follows the seventh cartilage. The soft parts are freed and retracted, the resulting wound being an ellipse. The seventh costal cartilage is divided at sternum. The soft parts are detached along its borders and the cartilage is lifted. It is easily freed from the perichondrium posteriorly. A complete subchondral resection is not attempted because the perichondrium anteriorly and at the borders is firmly adherent and is separated with difficulty. The cartilage is fractured about two inches from its sternal end

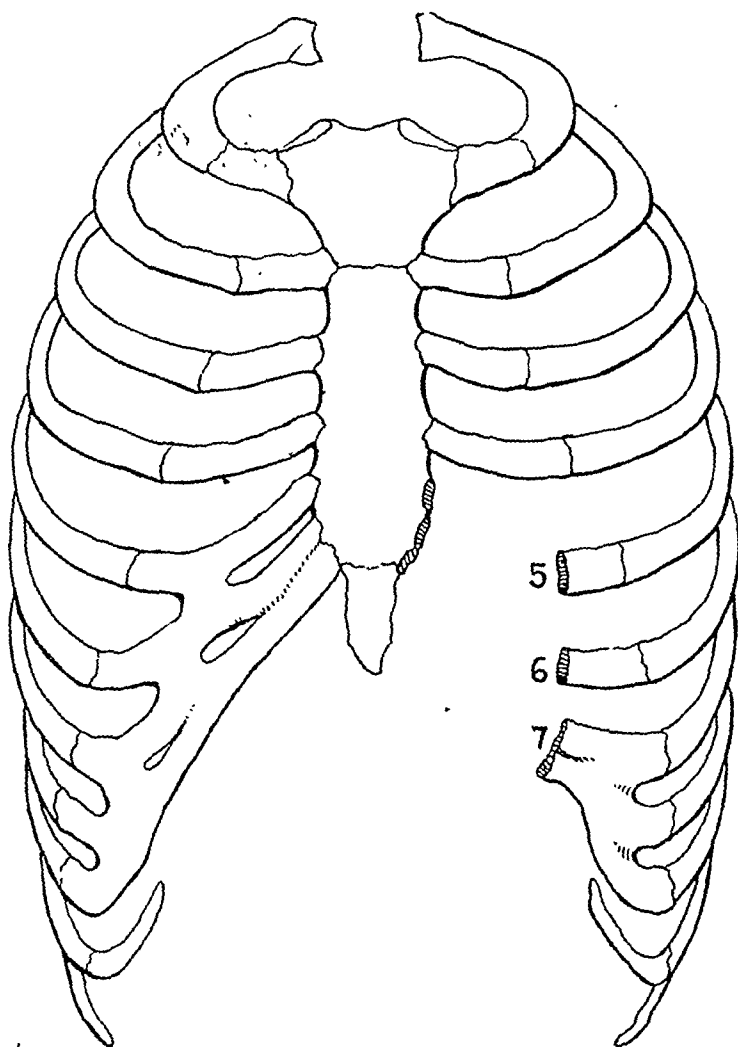


FIG. 12.—Exposure after removal of fifth, sixth and seventh cartilages.

The incision (Fig. 15) begins at middle of sternum at level of the lower margin of fourth costal cartilage; curving it passes downward and to the left to upper margin of chondrosternal junction of fifth; then downward close to the left edge of sternum, crossing the fifth and sixth cartilages to the middle of the seventh cartilage; curving outward it follows the seventh cartilage. The soft parts are freed and retracted, the resulting wound being an ellipse. The seventh costal cartilage is divided at sternum. The soft parts are detached along its borders and the cartilage is lifted. It is easily freed from the perichondrium posteriorly. A complete subchondral resection is not attempted because the perichondrium anteriorly and at the borders is firmly adherent and is separated with difficulty. The cartilage is fractured about two inches from its sternal end

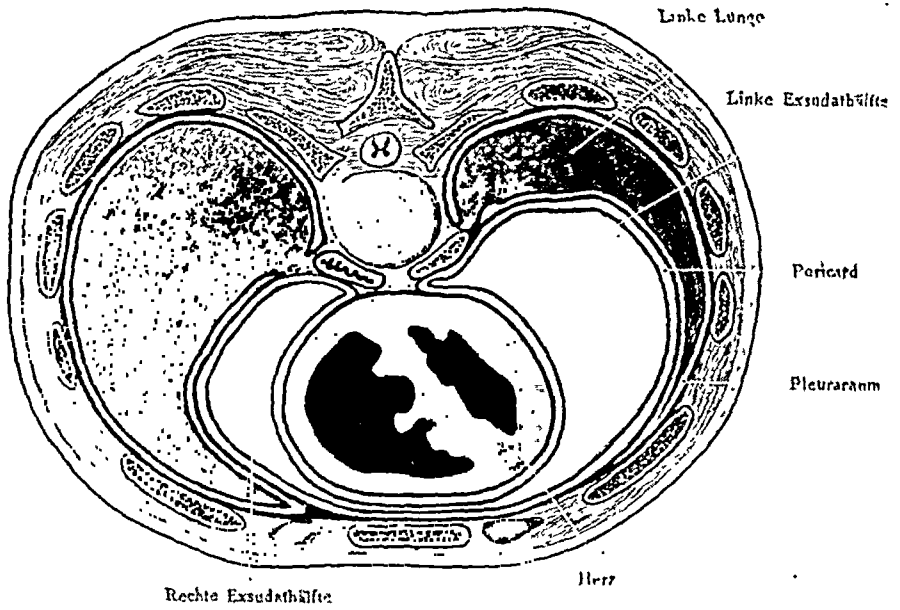


FIG. 13.—Position of exudate in distended pericardium. (Curschman.)

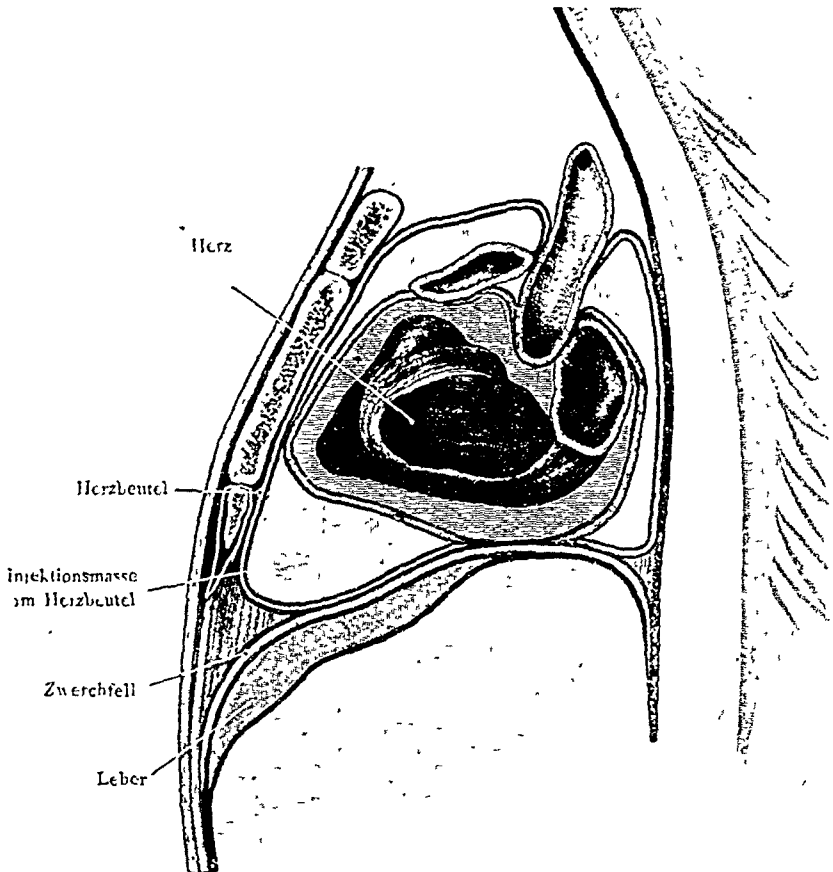


FIG. 14.—Position of exudate in distended pericardium. (Curschman.)

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and removed. The same procedure is carried out with the sixth and fifth cartilages (Fig. 16). The thin layer, including internal intercostal muscles and posterior perichondrium, is incised vertically and easily separated from the underlying tissues. This exposes the internal mammary vessels (Fig. 17). At the upper part of the wound they lie about one-half inch from sternum. They should be ligated above and below to lessen the danger of secondary hemorrhage. The thin triangularis sterni is separated from the sternum,

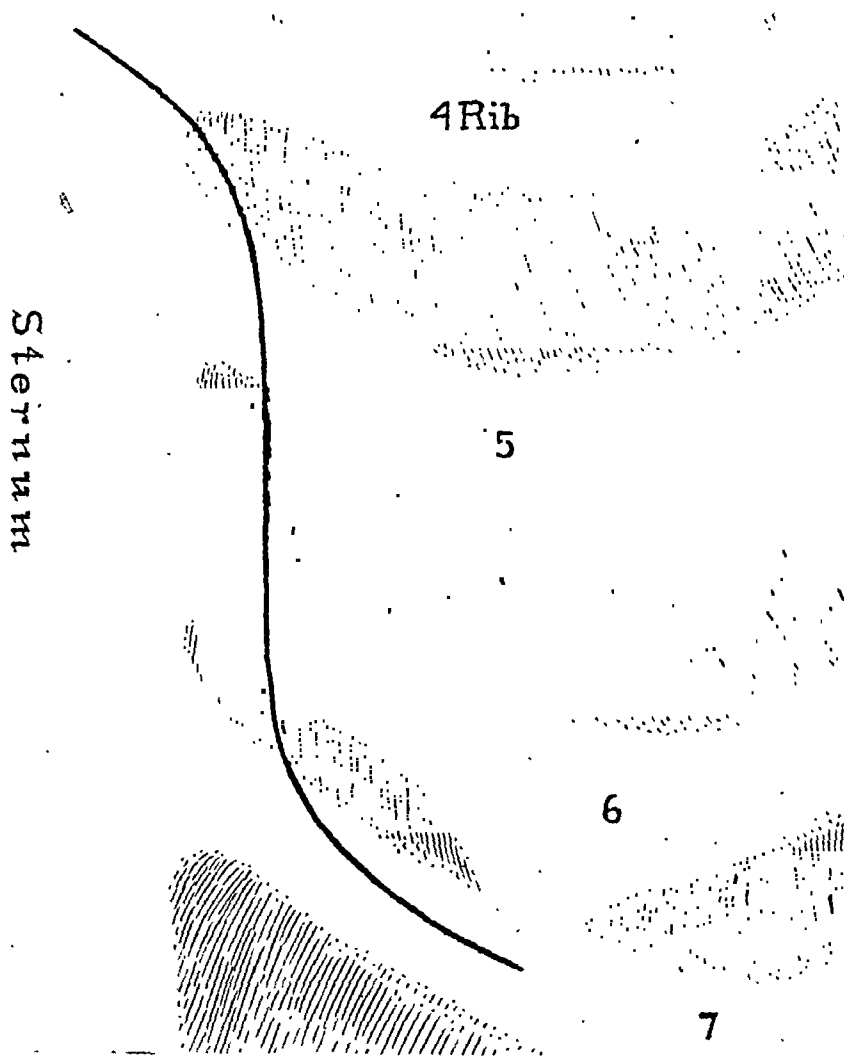


FIG. 15.—Incision for pericardiotomy.

and with finger or blunt instrument the underlying fat, and with it the edge of the pleura, is displaced outward (Fig. 18). The pericardium is thus exposed and is opened between forceps, about one centimeter from the edge of the sternum (Fig. 20). The incision should extend downward to the reflection of pericardium to the diaphragm. While the incision is in general vertical, it is advisable that it be slightly curved with concavity towards the sternum. This allows better separation of the edges and favors drainage. If possible the edges of the pericardium should be sutured to the skin or superficial soft parts to diminish the danger of mediastinitis.

Objection to removal of three cartilages may be urged on the ground that these patients are in too serious condition to warrant so extensive an operation. Yet in nine of the reported cases two cartilages were removed and eight of these cases recovered. The additional removal of a third cartilage should not be of serious import and should be more than counterbalanced by the advantages. Further objection may be raised that the operation is too extensive to be undertaken under local anæsthesia.



FIG. 16.—Cartilages resected, leaving posterior perichondrium and internal intercostal muscles.

thesia. This will depend upon the case and the operator. But it may be stated that general anæsthesia can be supported in a considerable proportion of cases. Of the reported operations in which a note has been found as to the type of anæsthesia twelve were general; over 50 per cent. recovered.

The question of drainage is important. In the case here reported the drain was removed in about thirty-six hours, two Carrel tubes were substituted and Dakin's solution introduced regularly. In another case I should begin the Carrel-Dakin method at once. It was here undertaken

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with some trepidation because it had apparently never been employed in the pericardium and I was uncertain as to its effects. Yet its indications seemed to demand it. On the basis of a former experience and the study of case reports, it was felt that thick pus with fibrin was likely to wall off the cavity into chambers, resulting in retained excretions and imperfect drainage, especially of the left recess. It was believed that the solvent effect of Dakin's solution would obviate this risk and would soon



FIG. 17.—The layer including internal intercostal muscles and posterior perichondrium incised vertically, exposing internal mammary vessels. (T. S., triangularis sterni.)

render the excretions thin and less in volume, besides gradually sterilizing the cavity. Practice confirmed the theory. Improvement was striking and sustained. The solution apparently exerted no noxious influence upon the pericardium and may, I think, be employed with confidence and advantage in subsequent cases.

Immediate Results.—Roberts, 1897; Porter, 1900; Eliot, 1909; and Rhodes, 1915, have collected the reported cases of pericardiotomy for suppurative pericarditis. According to Rhodes, the cases numbered eighty-six, of which forty-five recovered and forty-one died, a percentage

of 52.3 recoveries against 47.7 deaths. In the series the organism was reported in twenty-one only, the pneumococcus was found in nine cases, staphylococcus in four, streptococcus in three, a mixed infection of streptococcus and staphylococcus in two, the colon bacillus in one, the bacillus pyocyaneus in one, and a double coccus in one. The reports, however, are of very limited value for analytical study since details are often lacking. This illustrates the importance of full reports, not simply operative results, in such unusual cases.



FIG. 18.—Triangularis sterni separated from sternum. Finger displacing fat and pleura outward to expose pericardium (Pc).

An effort to collect more recently reported cases has added thirteen. It is noteworthy that the six cases which followed traumatism recovered, while of the seven non-traumatic cases only two recovered. This brings the total to ninety-nine cases with fifty-three recoveries and forty-six deaths. Summaries of these cases are appended.

Late Results.—The ultimate prognosis in a case of adherent pericarditis depends not only upon the extent and density of the intrapericardial and mediastino-pericardial adhesions, which may restrict the cardiac

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activity, but to a large extent upon the degree of myocarditis. In suppurative pericarditis the heart substance is always involved to some extent in the inflammatory process; degenerative and fibroid changes result and if extensive lead to dilatation. Resulting circulatory disturbances are often of late development. They are evidenced, according to McPhedran, chiefly by palpitation, tumultuous heart action, dyspnoea, a tendency to syncope and cyanosis, finally signs of cardiac failure, such



FIG. 19.—Diagrammatic: Portions of fifth, sixth and seventh cartilages removed. Approximate relations of lung, pleura and internal mammary vessels to line of incision in pericardium. - - - lung; ——— pleura; line of pericardial incision.

as anasarca and ascites, may supervene. On the other hand, according to the same author, light adhesions with little myocarditis may give rise to no functional disturbance.

To what extent myocarditis and adhesions cause functional derangement in drained cases of suppurative pericarditis is not evident from clinical observation. In only a few cases are the results recorded a sufficient period after operation to be convincing. Good functional results were reported in the following: Lilienthal's case, twenty years after operation; V. Eiselberg's case (Walzel), a boy of nine, was well nine

years after operation. Kiliani's patient, seven years; Eliot's, two years; Peters', a boy of seven, eleven months; the case here reported, eight months. Other cases, with the exception of Davis' case, are not reported later than four months. In two cases poor functional results are recorded: Davis' patient, a boy of eleven, one year after operation showed marked adhesive pericarditis; LeConte's patient (Scott), a male, aged thirty-six years, four months after operation palpitation persisted and prevented return to work.

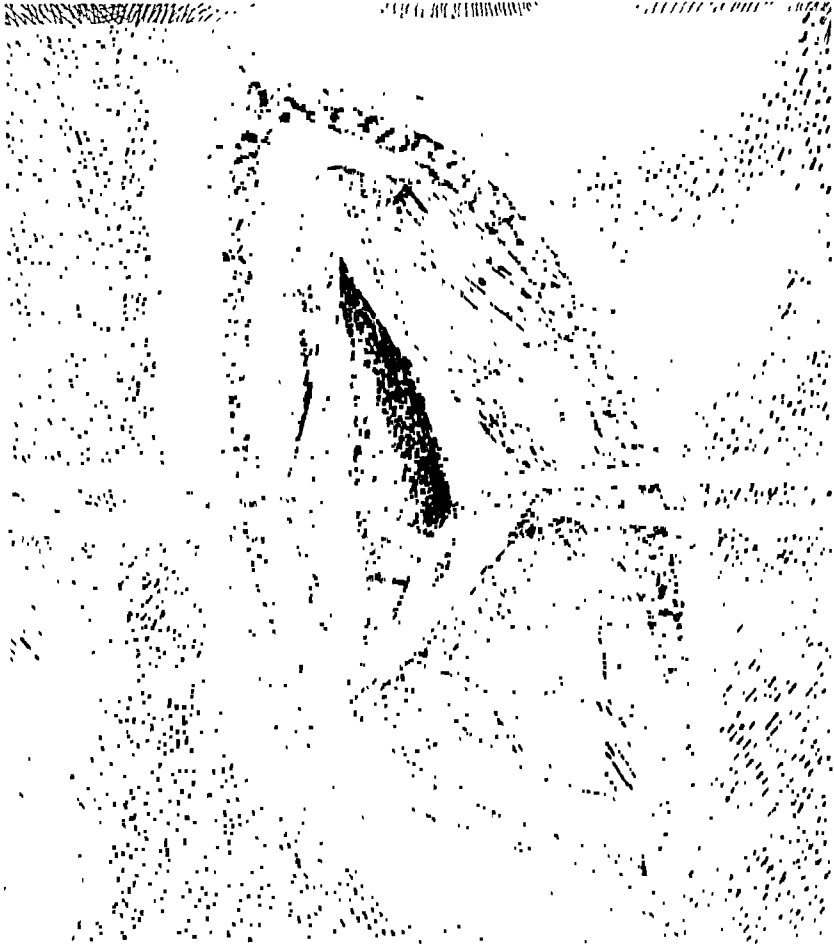


FIG. 20.—Pericardium opened, showing heart and diaphragm.

Presumably the earlier the drainage the less will be the myocardial involvement; moreover, it is possible that early treatment with Dakin's solution will diminish pericardial adhesions. Certainly the functional results will not be prejudiced by early drainage, while the immediate mortality will be reduced by timely operative intervention.

CONCLUSIONS

The method here described (resection of portions of the seventh, sixth, and fifth cartilages) meets the most important indications, namely, it opens the pericardium at its lowest part; involves little risk of injury

to the pleura; provides ample drainage and allows such exploration as is necessary both at the time of operation and during the post-operative course. If the condition of the patient warrants it, I believe this method is advisable, especially if a brief general anæsthetic can be tolerated. In some cases, a less extensive exposure may seem imperative. Under these conditions resection of the sixth and seventh cartilages seems best. The procedure was employed in the case here reported and gave quite satisfactory exposure and provided efficient drainage. In conjunction with the Carrel-Dakin method it probably would prove adequate for many cases. Resection of the sixth cartilage alone may be done readily under local anæsthesia and is tempting by reason of its simplicity, but the drainage is not satisfactory.

The Carrel-Dakin method appears well adapted to the post-operative treatment of suppurative pericarditis.

CASES REPORTED SINCE 1915:

BARIÉ AND LEBERT: *Bull. et Mém. Soc. Méd. Hôp. de Paris*, 1915, xxxv, 1042.

Pyopneumopericardium was observed in a man thirty-one years of age whose condition was not recognized accurately until five months after the onset of the disease, when pericardiotomy was performed.

Extremely offensive gas escaped, as well as a small quantity of offensive grayish fluid. Bacteriological examination showed staphylococci in large numbers and rod-shaped bacteria. The patient died six days after operation. Autopsy showed that the pyopneumopericardium was the result of œsophageal perforation, caused by a broken down tuberculous mediastinal gland. The œsophagus became ulcerated and then perforated, the ulcerative process extending to the pericardium, which also became perforated, with establishment of a fistula between the œsophagus and the pericardium.

BOIDIN, M.: *Presse Méd.*, Par., 1916, xxiv, 523.

Observation on a case of suppurative pericarditis caused by a small focus of superficial pulmonary gangrene, which was adherent to the pericardium and had infected the latter. The suppurative pericarditis behaved like a primary pericarditis. It was first punctured, and then treated surgically, but terminated in death.

ROBEY, W. H., JR.: *Am. Jour. Med. Sc.*, 1917, cliii, 529.

This paper is based upon a study of the protocols of eighty proved cases of acute pericarditis and the literature particularly of the preceding five years. It seeks to emphasize certain physical signs which have seemed of importance to the writer.

1. Man, aged thirty-two years. Had been ill two weeks with pneumonia, was improving, then grew worse. Diagnosis of pericarditis with effusion was confirmed by röntgen-ray examination. Needle inserted, gave 20 c.c. of sero-purulent fluid. Operation, 2 quarts of pus removed. Patient relieved, but died a few hours later.

2. Case of purulent pericarditis following pneumonia. Exploratory puncture made in fourth space to the right of sternal margin and operation followed, the fourth and fifth costal cartilages being resected. The patient made a good recovery and the discharge ceased in three weeks.

DAVIS, C. B.: Suppurative pericarditis. Demonstration of a case one year after operation. *Surgical Clinics of Chicago*, 1917, i, 375.

The patient, a boy eleven years of age, entered the hospital with multiple suppurating bone foci culminating in an attack of suppurative pericarditis. Exploratory puncture close to the sternum in the fifth intercostal space yielded pus; the fourth and fifth costal cartilages were resected for an inch and the pericardium exposed. An artery forceps was forced into the pericardial cavity by the side of the exploratory needle and a large quantity

of pus allowed to escape slowly. A soft rubber tube was sutured in the pericardial cavity and drainage was continued for several weeks. The pericardial shadow diminished, as was shown by X-ray examinations, and the pericardial wound healed in about four weeks. Bacteriologic examination showed pure cultures of staphylococcus aureus in all lesions. One year later, physical examination showed the presence of adhesive pericarditis, the pericardium being not only adherent to the heart, but also involved in a chronic mediastinitis and fusion of the pericardium with the pleura and to the chest walls. It is stated that besides being a good example of acute suppurative pericarditis successfully treated in respect to the immediate lesion, this case illustrates the typical post-operative results showing why the ultimate prognosis is so unfavorable, especially in children.

WILLIAMSON, C. S.: *Medical Clinics of Chicago*, 1917, ii, 907.

Patient, man aged forty years, with symptoms of acute miliary tuberculosis; duration of illness, eight days, with fever, chilliness, cough, and pain in the left side. The physical signs indicated pericarditis with effusion, and the fluoroscopic findings confirmed this assumption. A purulent exudate was suspected on account of the high leucocyte count, and diagnostic aspiration of the pericardium yielded thick creamy pus, which contained the pneumococcus in pure culture. Under local anæsthesia with novocain, the cartilage of the fifth rib was removed subchondrally and pericardium opened. Sixteen ounces of thick creamy pus, shown later to contain pneumococci, was removed. On digital exploration, no adhesions or walled-off pus cavities were found. Three gutta-percha drains were placed in different parts of the pericardium, drainage remained profuse to the end, seventeen days after operation, which was followed at first by temporary improvement. The autopsy showed acute fibrinous purulent pneumococcal pericarditis and hypostatic pneumonia of the dependent portions of both lungs, besides old calcified tuberculosis of the right lung.

CAMAC AND POOL: *Amer. Jour. Med. Sciences*, 1917, cliii, 509.

Male, aged forty-seven years, pneumonia lower right base. Twelfth day thoracotomy for empyema; staphylococcus aureus. Eight days later signs of pericardial effusion. Exploratory puncture revealed purulent exudate. Pericardiotomy under local anæsthesia, excising sixth cartilage; considerable pus evacuated. Two rubber tubes for drainage. Pus showed same organism as empyema. Marked temporary improvement, but sixth day femoral phlebitis. Blood culture showed staphylococcus. On thirteenth day after pericardiotomy patient died.

GUILLERMO, M. L., AND MONTOYA, J. M.: Pericardiotomy, Suppurative Pericarditis. Pericarditis supurada y pericardotomia. Report de Med. y Cirug. Bogota, 1917, ix, 115. (Abs. *Surg., Gynec. and Obst.*, 1918, xxvii, 217.)

Boy, aged eight years. Suppurative pericarditis following injury in precordial region. Under clinical observation for some time. No improvement. Operation: Under chloroform; transverse incision about 5 cm., starting from the sternal edge along fifth costal cartilage. Pericardium exposed, opened, and a quantity of bloody fluid drawn off; cigarette drain inserted; incision partly closed. Child able to get up on twentieth day, and made a normal and complete recovery.

The following cases resulted from wounds by projectiles:

ALBRECHT, P.: *Wiener Med. Wchschrft*, 1920, No. 1, p. 35.

Patient twenty-one years of age had been wounded in the chest by a bullet, but remained only a few days in the hospital. Soon after his discharge dyspnoea and palpitation developed, suppuration in the pericardium was suspected, and pericardiotomy was done. The projectile could not be found on exploration of the pericardium, which contained much sero-purulent fluid with some fibrinous adhesions. The adhesions were detached and the wound was drained; the drainage-tube was covered with a rubber stall in order to prevent the aspiration of air. The pulse-rate dropped to about 80 soon after the operation, and the patient made a good recovery.

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JONES, L.: Gunshot wound of the pericardium and heart. Pneumohæmo-pericarditis. Operation. Recovery. *British Journal Surgery*, 1916, iv, 103.

Patient a soldier, aged thirty-eight years, who was wounded by high-explosive shell and admitted to hospital with two shell wounds of the chest-wall. The wounds were infected. Diagnosis of pericarditis was confirmed by X-ray examination. The extensive dulness was seen to be sharply localized and due to an extensive pericardial effusion. Operation under ether anæsthesia. Incision following the border of the seventh costal cartilage and the middle of the sternum; portions of the seventh, sixth and fifth costal cartilages and half the width of the sternum were removed; the pericardium was incised vertically for two inches. A large quantity of foul-smelling gas, and offensive fluid measuring 22 ounces escaped. The foreign body was not in the pericardium. A flanged rubber drain introduced into the pericardial sac. Part of the wound sutured. Iodine solution was used for flushing the pericardial cavity until the wound had entirely healed, which occurred in seven weeks. Electrocardiograph examination three and a half months later showed no evidence of hypertrophy or dilatation. No murmurs were heard; none of the cardinal signs of adherent pericardium were observed. An X-ray plate showed that there was no increase in the size of the heart. Patient in good condition.

KLOSE, H.: Ueber eitrige Pericarditis nach Brustschüssen und pluerale Pericardiotomie. *Beiträge zur. klin. Chirurgie*, 1916, ciii, Kriegschirurg Heft, vi, p. 556. Medical supplement, *Daily Review of the Foreign Press*, 1918, i, 53.

The author reports four cases of suppurative pericarditis following bullet wounds of the chest. Three died, and one recovered after extrapleural pericardiotomy under local anæsthesia by Rehn's costo-xiphoid incision.

CRABTREE: *Mcd. Press*, London, 1919, n. s., cvii, 472. A Case of Successful Operation for Wound of the Heart.

Soldier, struck in chest by spent bullet, November 8, 1918; admitted to No. 22 General Hospital on November 9th. Entrance wound two and one-half inches to the left of sternum between fourth and fifth ribs; slight purulent discharge; pericardial friction over whole cardiac area; no evidence of fluid; chest clear. X-ray examination showed bullet in heart shadow. Bullet moved with heart's impulse. In view of extreme pain and infected pericardium operation was determined upon.

November 13th. Eight-inch incision made to the left of sternum, curving outward along the sixth rib. Fourth and fifth costal cartilages and one inch of each of corresponding ribs resected. One-half inch of left margin of sternum was removed. Pericardium was opened by a T-shaped incision to give access to extreme left side of heart. Considerable thin pus escaped. Area of fibrin and adhesions was found between the visceral and parietal pericardium on the extreme left surface of heart near the junction of the left auricle and ventricle. The bullet was found to lie tangentially to the cavity of the heart, buried in the heart muscle, but had not penetrated cavity. Owing to sepsis, the wound in the heart was not sutured after the removal of the bullet. The incision in the pericardium was loosely sutured about the rubber tissue drain. Muscle and skin flaps were sutured into place. Recovery was uneventful, save for the collapsed left lung. March 13, 1919, patient was well.

The report states that this was the twelfth case of heart injury in the British Army to be operated upon, and was one of the four recoveries.

NOBLE, T. P., AND VINE, A. B.: Note on a Case of Pericardiotomy. *Lancet*, London, 1919, i, 107.

Soldier. Pericardiotomy performed on twelfth day after passage of rifle bullet through chest, with recovery of patient.

Wounded April 11, 1918. Bullet entered in the third interspace, one-half inch internal to nipple line on the left side, exit one and one-half inches to the left of midline behind, on a level with seventh dorsal spine. Apparently punctured pericardium and grooved muscular wall of heart. April 21st, symptoms bad; X-ray confirmed pericardium distended with fluid.

Operation.—General anæsthesia with chloroform and ether. Incision along fifth rib and cartilage from midline to nipple line, fifth costal cartilage resected, vertical incision in pericardium; finger insinuated between right auricle and pericardium and left ventricle and pericardium; escape of quantity of cloudy fluid, which was found to contain a short streptococcus. Glove drains inserted to the right and left inside the pericardium, wound closed; drains removed two days later, wound healed by first intention. Recovery in four weeks, and improvement maintained two months later.

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DIAPHRAGMATIC HERNIA

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TRAUMATIC diaphragmatic hernia has been shown to be not as infrequent in the adult, as was previously thought. Such hernias have often been reported during the great European war as arising from gunshot, bullet, shell and stab wounds of the diaphragm. Still the clinical diagnosis is no clearer than it was heretofore. Congenital hernias of this sort are quite infrequent in the adult, and it is for this reason that this case is presented as for the fact that this condition may be mistaken for very much more frequent conditions and so a fatal error in treatment be made.

The patient was a widow, aged sixty-five years. Her chief complaint was discomfort in the left chest and dyspnoea.

Her symptoms date back many years. The patient cannot furnish any history of a sudden onset nor of a time when she was entirely free from symptoms, nor can she furnish any history of a trauma of such a nature as might be capable of resulting in such a hernia. She has some sort of discomfort on her left side which is relieved by belching, which she does often, and which has no relationship to meals. She describes cramps of an indefinite nature beneath the costal margin on the left side, and also complains of occasional sticking pains in the left chest. She is markedly dyspnoeic, particularly so on exertion and has been so for the past ten years. For the same period of time she has had some gravitation oedema after walking. She has attacks of palpitation occasionally. Her upper and lower extremities are always cold, particularly in the morning. She suffers with some dizziness and has a poor appetite. Despite all this she was able to gain weight after a rest in the "country." Her habits are good. She drinks tea and coffee in moderation. She has a marked polyuria both day and night.

Physical Examination.—When admitted there was marked visible pulsation in the neck on both sides, but more marked on the right. There was also a fullness of the lateral part of the neck on the left side, which is not accounted for by enlarged cervical glands or a large lateral lobe of the thyroid gland. The antero-posterior diameter of her chest was markedly increased. By measurement the right side of her chest was markedly larger than the left. The angle of Ludovici is very prominent. The left infra- and supraclavicular depressions are more marked than the right. The pulsation in the right supraclavicular fossa is more marked than the left.

On *palpation* cardiac pulsation is felt antero-laterally on the right

side and not at all on the left. There is no bronchial fremitus felt on either side. Vocal fremitus is felt on the entire right side with the exception of the heart area. On the left side it is absent with the exception of a small area in the suprascapular region above the spine of the scapula. There is no expansion of the left chest either visible or palpable. The right expands normally.

The *percussion* note anteriorly in the left supraclavicular space has a peculiar mixed emphysematous and tympanitic quality. Below this the note becomes more tympanitic and is almost skodaic in the second intercostal space. The note then becomes absolutely flat to the base. On the right side, anteriorly, the note is emphysematous throughout with the exception of the cardiac dulness which will be described later.

Posteriorly the right side gives an emphysematous note throughout. The left side gives a similar note to the inferior angle of the scapula. Below this it is flat to the base. In the axilla on the left side the emphysematous note extends to the seventh rib and then becomes tympanitic, as if the stomach lay high.

On *auscultation* anteriorly the breath sounds are heard down to the second rib on the left side and not at all below this. Posteriorly the breath sounds on the left side are heard only a little at the apex and slightly along the vertebral column for a short distance.

On the right side the breath sounds are accentuated as in compensatory emphysema. They are absent over the area occupied by the heart on the right side. Over the right base posteriorly and laterally are heard a few crackling râles.

The voice sounds are normal on the right side, front and back. On the left side anteriorly they are heard to the second intercostal space and posteriorly as far down as the spine of the scapula.

Heart.—There is visible pulsation in the fourth intercostal space on the right side in the midclavicular line. The apex beat apparently is felt in the fourth intercostal space 11 cm. from the midsternal line on the right side, a little to the right of the midclavicular line. Cardiac dulness percusses to the anterior axillary line on the right side. No heart sounds are heard on the left side. On the right side no abnormal sounds are heard. The second sound over the normal aortic area is accentuated.

The *blood-pressure* was 150 mm. systolic and 100 mm. diastolic on the left side and 164 mm. systolic and 100 mm. diastolic on the right side, a difference of 14 mm. mercury favoring the right side.

The *coin test* was positive on the left side. There was no *succussion*.

The *abdomen* was flabby throughout. The liver and spleen were not felt. There were no masses felt. All the *reflexes* were normal.

The *röntgenological examination* showed the heart to be on the right side. The right lung was well aerated. On the left side lung tissue was confined to the extreme upper part of the left chest and was separated from an abnormal area by a linear dense shadow made up of the dense fibrous, almost calcified lining of the cavity

containing the hernia. Below this could be made out some coils of intestine and the fundus of the stomach which lay above a distinct linear shadow of the diaphragm which seemed to lie a little higher than that on the right side. It was impossible to get a gastrointestinal series of pictures because the patient refused the bismuth meal.

Discussion.—There is perhaps no condition that is so difficult of recognition clinically as diaphragmatic hernia. Here we have an adult that upon first examination would seem to have a collection of fluid in the left chest. The variability, however, in the signs in front and behind led us to have an X-ray taken, and this revealed the condition.

If there is anything of more interest in this case than anything else, it is the fact that a patient with a very large diaphragmatic hernia can get about with comparative comfort and successfully pass through two attacks of what is evidently a respiratory infectious disease, influenza. It seems that this in itself should lead not only to greater care in physical examination and the more frequent use of the Röntgen-ray in chest work, but above all to the idea that many of these cases may be left alone, for the operation is one of considerable difficulty and should be performed only in emergency, *i.e.*, when there is evidence of intestinal obstruction. This case also lends support to the probability of the more frequent occurrence of diaphragmatic hernia in even the presumably healthy, for such can give not only very variable signs and symptoms, but often no signs or symptoms at all, as, for instance, the absence of physical signs in the left axillary region in this case.

As far as clinical diagnosis is concerned, we think there is nothing of such great significance as the variability in signs in various parts of the same side. The presence of air as evidenced by the coin test, if present, is a valuable aid. Of course there is nothing like the X-ray, but one must be led to this by the physical findings and the tentative clinical diagnosis.

THE PRESENT STATUS OF GASTRIC AND DUODENAL ULCER

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FOR practical purposes chronic (sometimes called "peptic") ulcers of the stomach and duodenum conform themselves to one of two types: The first of these—and, perhaps, the less important—are the soft lesions characterized (1) by their relatively smaller size, (2) by their superficial extent, (3) by the failure of the process to penetrate any deeper than the submucosa, (4) by the absence of surrounding areas of induration; noted (5) by the frequently greater benignity of the clinical course, (6) by the tendency not to undergo malignant transformation, (7) by the frequency with which cures are obtained with medical means alone. The second are the lesions characterized (1) by their comparatively larger size, by their deep penetration and frequent perforation, (2) by their marked induration and by their numerous and dense adhesions to surrounding organs, especially to the pancreas; (3) by their marked chronicity and frequent "relapses"; noted (4) by the frequency with which malignant changes are found throughout the lesion or limited to its bed or margin; (5) by the tendency to complications of a mechanical nature accompanying their progression. There are cases, however, in which the characteristics of the one overlap into that of the other, or in which a proper distinguishment of the lesion is made difficult or impossible because of many associated phenomena frequently of a functional nature.

In any case the trend of our knowledge is towards the assumption of the theory that defects in the gastric or duodenal wall, quickly forming or slowly forming, appear frequently and because of more than one cause, and that the opposing forces in the gastric or duodenal physiology are so accurately balanced as to assure under ordinary circumstances an extraordinarily rapid healing. In a number—of which the relative percentage is not known—the healing is prevented by some factor which, up to the present, has remained undiscovered. It is quite possible and probable that this unknown factor may of itself be one of the agents capable of producing the original defect, in which case the continuance of its presence prevents the natural healing, or it may have become secondarily superimposed upon the original circumstance which had yielded or permitted the primary lesion.

The old conception that a typical history indicates absolutely the presence of an ulcerative lesion in the stomach or duodenal wall seems to have been generally abandoned. It is quite true that many times the operative exploration fails to reveal the presence of any ulcer; but it is equally true that just as often a rather indefinite or trivial history is

proved to be due to very large lesions in the wall of the stomach or duodenum. Experimentally it is rather well known that defects in these organs can be produced in very many different ways and repeatedly in the same animal and that all of these artificially made lesions have the marked tendency to heal very promptly and rapidly. It does not seem unreasonable to assume that in human pathology there are numerous occasions when temporary defects of relatively similar origin and nature appear in the stomach and duodenum and that these, too, should have the characteristic of healing quickly. Unless these would be looked for within a reasonably short space of time the likelihood is very strong that they could not and would not be demonstrable on the operating table. Yet such lesions would give symptoms; and there is no reason why the symptomatology should not be as typical as any described. It is conceivable, therefore, that the original viewpoint of Moynihan and others may have some basis of truth; namely, that a typical history always spells an ulcerating lesion, with the distinct proviso, however, that a great many of these undergo rapid and spontaneous healing. If placed under treatment recovery would follow with complete disappearance of the symptoms and the effect might be a permanent one. I am quite sure that many of the "medical ulcers" are of this type. If for any reason new ulcers developed subsequently, the symptoms would reappear and, as healing again took place, these would disappear once more. A great many of the remissions seem to be explainable on this basis.

I have the impression that lesions of this kind are comparatively small and are frequently in the duodenum—perhaps somewhat more frequently there than in the stomach. They are the kind which give little or no positive evidence of ulcer objectively, especially with the Röntgen-ray. They are the kind which give most of the medical cures and for which surgery of any kind is not indicated and may even be harmful.

There is no positive evidence to prove either that the large indurated ulcers have their beginnings in acute defects which originally have the tendency to heal, or that they begin as indurated lesions and continue so. Clinically periods of remissions have been noted with indurated lesions also; and when the latter are demonstrated on the operating table, the history of remissions of symptoms make it open to serious consideration whether, originally, acute healable defects had been present which, having healed and recurred, have later been transformed into the indurated type of ulcer. I believe that when once the indurated lesion has become well established there is little or no remission in the symptoms and that the latter, as well as the actual pathological process, become progressive.

The diagnosis of ulcerative lesions of the stomach and duodenum has been difficult; it requires time, study, patience and a careful checking up by the various laboratory data. The elicitable symptomatology can be grouped accordingly as it is referable (1) to pain, (2) to disturbed gastric

function, (3) to disturbances in other organs, (4) to hemorrhage, (5) to perforation, and (6) to resulting anatomical deformities of the stomach. The Röntgen-ray is of tremendous importance in making the diagnosis; with the passage of time and the accumulation of much experience it has succeeded in establishing for itself a most dominant position; so much is this so that very frequently now the other factors serve but to attract one's attention to the stomach or duodenum as the organ which is at fault. When the Röntgen-ray demonstrates the presence of a distinct penetration all other evidence of a diagnostic nature fades into obscurity because of its comparative inutility. When no such positive evidence is demonstrable in the fluoroscopic examination the method, in the very best hands, furnishes still the very best and most satisfactory corroborative evidence of the presence of a gastric or duodenal lesion; under these latter conditions, however, the Röntgen-ray evidence is not infallible. This is especially so with the duodenal cases, and frequently the operation must necessarily assume the characteristics of an abdominal exploration.

Estimations of the functional capacity of the stomach—that is, of the chemical and motor activities—have virtually lost all of their importance as diagnostic aids. The danger here lies in the fact that the delegation and submergence of these elicitable data to very unimportant positions in the diagnosis may be so complete as to result in their being dispensed with altogether for any purpose whatsoever. The information derived from these sources, however, is really of great importance and should be carefully determined in each individual case. With the exception of pain, almost the entire symptomatology is due to disturbances of physiology both in the secretory and in the motor function, and the satisfactory explanation of the coarser and finer differences in each individual case is frequently only determinable upon the variations of the several functions from their established normal. Estimations of the variations in function can be determined quantitatively. As pointed out in a previous communication, the determination of the beneficial effect of any operation or line of medical treatment and of the subsequent improvement in function—which frequently, but not always, goes hand in hand with any improvement in the symptomatology—is also measurable and comparable in the subsequently repeated estimations of function; and, when in the the post-operative course prolongation of or renewal of symptoms occurs, it is possible frequently and similarly to interpret the latter in the light of any associated disturbances of function.

In the actual gastric pathology disturbances of the chemical function play a less important rôle. Digestion of the food can be very adequately done in the small intestine, and the chief duty of the stomach is to prepare the food for its further intestinal digestion. Disturbances of gastric chemism resulting in an inadequate preparation of food can be and frequently are, therefore, reflected in intestinal symptoms.

Much the more important rôle belongs to the motor function. If the

stomach be properly emptied in a normal interval—with due regard to the character, composition and preparation of the food intake—the disturbance resulting from any associated variation from the normal of the chemical function, while distinguishable to any observer, gives such little perceptible evidence and is so easily tolerable to the patient as to readily escape notice. Evidence of disturbance of the motor function is, however, immediately productive of symptoms. The more common derangement, that is observed, is a retardation of the passage of food and a lengthening of the total emptying time of the stomach. When associated with ulcer the interference with the muscular activity may result from an organic obstruction at the pylorus serving to nullify a primary exhibition of increased muscular effort, or it may be a reflex phenomenon associated with the presence of a lesion in the body of the stomach, usually on the lesser curvature and posterior wall, which from its very onset is a progressive decrease of muscular effort combined with pylorospasm; in either case the extreme end-result is a paralytic atony of the stomach musculature. With ulcerative lesions both of these varieties occur in about equal proportions.

In ulcer cases the extreme condition mentioned—atony—should receive the most careful attention both before and after operation. The importance of the observation lies in the fact that in the more advanced cases the condition is beyond recovery; operation is then not followed by the improvement in symptoms which had been anticipated, even though the offending pathology has been entirely removed and the mechanical conditions for drainage have been enormously improved by the operation; symptoms are many and distressing; and treatment is very difficult if not impossible. In the more fortunate cases the atony is still in condition for recuperation to take place: this may be a very rapid process and then the success of the operation from the symptomatic point of view is all that is to be desired and is very prompt; in others the recovery of the normal tone and function is more slowly accomplished; and for these patients the services of the expert medical man are most necessary and desirable, especially in the immediate post-operative period and until full functional recovery is reached.

In many patients—though not occurring as often as the derangement previously described—the disturbance in muscle function is not a retardation but an acceleration of activity leading to the emptying of the stomach much before the normal emptying time. This disturbance is not as frequently noted before operation as it is afterwards. Then the mass of stomach contents is hurriedly emptied into the duodenum and jejunum in a state of insufficient preparation, because of which an irritant effect is exercised upon the intestine. The duodenum and jejunum become unduly distended and overdistended by the unexpected mass of stomach contents; in the effort to rid itself of this unwelcome burden peristalsis is enormously increased and the intestinal contents hurriedly passed on.

The effect has certain similarities to that obtained when the chemical functions are at fault; the similarity is quite true, for in both the disturbance is a quantitative one. Of the two—retardation and acceleration—the latter, perhaps, is capable of creating more harmful effects and more distressing symptoms; the commonest symptoms include diarrhœa and loss of weight.

With the means at present at our command it is not possible to make out any relation between the position, the character, the extent, the degree and severity of the symptoms complained of and the size, location, depth of the ulcer, or the presence or absence of associated or consequent anatomical complications. The character of the functional disturbances seems also to have no mathematical relationship to the lesion present. No correlation can, therefore, be made between the clinical picture with its varied symptomatology and laboratory findings which the individual case presents and the lesion which is present and which one is about to treat. No prognosis can be made of the rapidity with which the lesion will yield to treatment nor of the character of the post-operative course if operation be undertaken. This state of affairs is probably due to the presence of associated factors about which we have no, or very little, knowledge and which probably exercise important functions in determining the character of the clinical picture.

There is reason to believe that some, if not many or all, of the individual functions of gastric physiology are controlled by the internal secretions either alone or in conjunction with nervous impulses. The physiological purpose is attained by the orderly working of all of the various forces indicated, and it is perfectly reasonable to assume that in an unknown number of cases disturbances of stomach functions—hyperacidity or hypoacidity, or atony or hypermotility of the musculature—are concrete perceptible reflections of abnormalities in the endocrine organs. Such a theory explains many things in functional and organic disease of the stomach; it helps to clear up the etiology of hyperacidity, hypoacidity and anacidity which have no apparent anatomical basis, and gives a cause for an hitherto unexplained hypermotility or atony of the musculature; and when an anatomical lesion, such as an ulcer, is demonstrable, it helps to make clear the mechanism whereby the organic lesion causes the accompanying disturbances in secretory and motor function. The apparent discrepancies between anatomical lesion and symptomatology and laboratory data indicated previously are probably explainable on this basis.

Hæmatemesis has always been an important symptom and factor in the clinical complex of ulcer. Frequently it is the only symptom. It is well to remember that, as a symptom, hemorrhage from the stomach or duodenal wall with, or without, the vomiting of blood, marks a large number of clinical pictures of which the well-known lesions of ulcer form only a part. Other causes for this phenomenon include the lesions of

tuberculosis and syphilis, and benign and malignant tumors as well as those in which recognizable lesions are present in the liver, or in the spleen, or in both of these organs. Gastric hemorrhage is also known to occur during some of the infectious diseases, such as pneumonia or typhoid; and as a result of certain infective foci situated in other abdominal viscera, notably the appendix. Finally, there is the group of "gastrostasis" cases (Hale White).

Penetration of the lesion occurring through the base of an old established ulcer and when the nourishment of the patient is approximately at par results from the gradual progression of the pathological process and is invariably accompanied by the formation of protecting adhesions around the lesion on the peritoneal side of the stomach wall, which effectually lead to a safe walling off of the base of the ulcer and to the prevention of any sudden outpouring of gastric contents into the free peritoneal cavity. There have been numerous experiences during the course of chronic ulcers in which the patient gave sufficient general and local evidence of this emergency to ensure the accuracy of the diagnosis; the symptoms subsided very quickly, however, and thereafter the course of affairs was not different from that previously experienced by the patient; in a number the assumption was confirmed by operation undertaken a few days subsequently.

A sudden perforation into the free peritoneal cavity through the base of an old ulcer under the conditions just described is indicative of a lack of healing power on the part of the individual. The mechanism, in some of the cases of this kind, may, however, be independent of the healing powers of the individual, and is similar to that which causes the occurrence of acute perforations in the absence of any preëxisting perforative lesion. Here it assumes the characteristics of an embolic phenomenon occurring during the course of some temporary bacteriæmia, the evidence of which may be so transitory as to be undemonstrable. There is much evidence in the fields of experimental and in that of clinical medicine which makes this assumption highly probable. Experimental evidence in which resulting necrotic areas occur simultaneously in various parts of the alimentary canal, notably in the appendix and in the stomach, goes to show that under these conditions (that is, in the absence of any preëxisting ulcer) the mechanism of an acute perforating appendicitis and of a stomach or duodenal perforation are essentially the same. The subsequent histories of these cases give valuable corroborative evidence. In those of the stomach or duodenal perforation cases in which the emergency is not fatal and recovery follows operation, and in which only a suture of the perforation has been made and no complicating factor—especially a gastroenterostomy—has been added, it is the rule for the recovery to be permanent and for no post-operative symptoms to make their appearance. In this regard the accident of a perforation in the stomach or duodenal wall is exactly similar to that of a perforation of the

appendix. The exceptions to this rule, which, probably, are quite constantly occurring, are due to the prevention of the healing of the defect, produced by the perforation, by the superimposition of that unknown factor causing unhealable chronic ulcers as indicated in the early part of this communication.

This conception of the mechanism causing acute perforation of the stomach or duodenum furnishes a plausible explanation for the frequently heard statement that perforation of an ulcer often results in its healing. This statement is both true and not true; true in so far as it applies to acute perforations of the embolic type occurring in a previously healthy stomach or duodenal wall; not true in so far as it applies to acute perforations occurring through the base of an old established ulcer. The persistence of symptoms subsequently to perforation indicates the presence of the latter state of affairs.

For a number of years American opinion in regard to the relationship of ulcer and carcinoma of the stomach has been influenced by reports from certain quarters that ulcer precedes carcinoma in a rather large number of cases. Originally the figures were put very high, almost three-fourths; latterly the percentage relationship has shown a decrease. In other quarters, especially among men who were more inclined to look upon the lesion from a purely pathological standpoint, the opinion tended to the opposite, did not recognize such a large percentage relationship, assumed that the carcinoma had preëxisted in the largest number of the cases and that the ulcerating defect was a secondary phenomenon unrelated in its formation to the mechanism of a benign lesion and was due directly to the varying amount of necrosis which so frequently takes place in any new growth. Among the latter group of men it is estimated that this biological sequence (ulcer to carcinoma) does not occur in more than 2 or 3 per cent. of the cases.

Abroad the opinion has always and most commonly agreed with the latter point of view; perhaps this is so because in European centres opinion is usually decided upon pathological evidence obtained in the post-mortem room. Another source of confusion has always been the difficulty of distinguishing properly between true cancerous tissue and the many forms of atypical proliferation resulting in most peculiar morphologies in regenerating gastric glands; there is no means at the present writing which enables a proper interpretation of the latter except by their ultimate outcome.

Some points of analogy in regard to this relationship can be drawn from similar lesions in the duodenum. It is possible to find but few reports in the literature of cases of carcinoma of the duodenum located exactly in the most frequent ulcer-bearing area, *i.e.*, within the first one and a half inches of the duodenum. Lichty pointed out that, although cancer of the duodenum was first described in 1746, comparatively few cancerous lesions have been found and described since. Ulcer of the

duodenum is, however, an extremely common lesion. The mechanism of ulcer formation in the duodenum is of a similar order to that of the stomach, and the comparative rarity of cancer of the duodenum speaks volumes as regards the relationship to the latter of any preëxisting ulcer when compared with similar relationships in the stomach; the inference is obvious.

As the cases are met on the operating table the difficulty, in practical surgery, always arises with the large crateriform, penetrating and perforating lesions on the lesser curvature and posterior; the difficulty is one of interpretation of the anatomical lesion from its gross appearances. The markings of such lesions, visible to the naked eye, frequently do not betray their microscopical structure. The truth is that many of the lesions show every characteristic in their gross appearance of a benign lesion and their malignancy is only apparent under the microscope. The important point to remember is that, in actual practice, it is much better and safer to regard every one of these lesions as potentially malignant growths until their true nature is demonstrated conclusively under the microscope. About 18 per cent. of ulcer-like lesions are carcinomata.

The rational treatment of ulcer is a very difficult matter and should be determined for the most part upon the anatomical characteristics of the lesion present. When the evidence is essentially indirect and more or less of a presumptive nature there is room for a difference of opinion as to the proper therapeutic course to pursue. When the evidence, however, is direct and conclusive there is no room for argument, and there is only one rational course to pursue; these latter lesions are those which can be definitely demonstrated as perceptible defects in the röntgenographic examinations.

The general opinion that the great majority of gastric and duodenal ulcers can be cured by medical means alone and can be kept cured under proper after-treatment is susceptible to some modification and is properly applicable to cases in the first group only—that is, the soft ulcers. The further opinion that most medical men push the matter of medical therapy too far and that an ulcer persisting after proper medical treatment becomes a surgical malady is one which necessarily must also be modified in view of the newer knowledge regarding ulcer and its manifestations and complications. In the cases in the first group mentioned, I believe that when there are no complicating factors present in addition to the general and ordinary manifestations of ulcer—and by this I mean especially when there is no evidence pointing to a distinct retardation of the emptying power of the stomach—medical treatment should be persisted in alone. When stasis in the stomach is well established and the drainage of the organ is unsatisfactory, then surgery is indicated without any unnecessary waste of time to restore the emptying power of the stomach to its normal condition; the important point to remember, and one which I shall refer to again, is that the surgical means em-

ployed to secure this improvement in drainage should be one which will not disturb the anatomical arrangements and relationships of the stomach, or if it necessarily must do so, that the procedure be done in such manner as to permit at some subsequent time, if it prove necessary, the restitution of the organs to their normal status; this refers especially to the operation of gastroenterostomy.

The appearance of certain other complications also indicate the necessity for surgical interference: these are (1) repeated hemorrhages and (2) cicatricial deformity of the stomach either at its outlet (pyloric stenosis) or in its body (hour-glass deformity).

When a large crateriform lesion is demonstrated by the Röntgen-ray surgery is absolutely essential because of the following considerations: (1) the knowledge that such lesions practically never heal spontaneously;* (2) the danger (18 per cent.) of malignancy; (3) to prevent deformity of the stomach; and (4) to prevent any irreparable damage to the functions of the stomach both on the motor and chemical sides.

One seems to be passing through a transition stage in so far as the treatment of chronic ulcer concerns us. In the beginning gastroenterostomy was deemed sufficient, and it was not until some time had passed and, more and more, the inefficiencies of the method of operating were brought home to us, that new methods, or rather new additions to the old method of gastroenterostomy, were diligently looked for and devised in the hope of securing a reliable means of curing ulcerative conditions. A great deal has been attributed to the method of making the anastomosis—to the relative point of the stomach at which the implantation of the jejunum is made, to the direction of the loop, to the size and direction of the stoma, to the kind of suture material used, and to the skill with which the necessary manipulations are carried out. Much of this seems quite true, as the records of any large hospital will show, and numerous sequelæ, which follow after operation, are undoubtedly consequences of the manner and method by which the stoma is made. But, unfortunately, this is so in a very small minority; and experience has multiplied the cases in which recurrences of symptoms, or lesions, follow operations concerning any part of which no criticism is permissible.

There does not seem to be any accurate knowledge of the exact factor in the functioning of a gastroenterostomy which exerts the beneficial effect, which is said to follow, and which assures the healing of the ulcer. Opinions have, and do still, differ and vary from the belief that the desirable effect is purely mechanical in helping to empty the stomach in a shorter than normal interval, or, at least, in side-tracking the food away from the ulcerated area, to the more prevalent interpretation that the good effect resides in the continued partial, or complete, neutralization of the hyperacid condition of the gastric contents. In the absence of definitely proved data of the actual factors causing the so-called good

* At the most the number of these lesions that heal are very, very few.

effect, theories as to why the gastroenterostomy is followed by many recurrences, both of symptoms and lesions, seem to be based on insecure foundations, and no criteria are available upon which one can accurately base the modifications with which one seeks to improve the results of gastroenterostomy, or upon which one can construct more reliable methods of operative, or other, treatment.

It is difficult to understand in any individual case the relation of the post-operative clinical facts to the laboratory examinations, for it is found that subjective cures may be obtained when the laboratory examinations indicate a disturbed physiology, and post-operative symptoms may appear when the functions seem to be improving or when they are within normal limits. The following facts are, however, worthy of consideration: (1) The symptoms need not necessarily be due to the disturbances of function. (2) The symptom may be pain. (3) The ante-operative symptoms and complaints and disturbances of function may have been so marked that the immediate relief obtained by operation, even if it be only temporary, overshadows completely any residue of the subjective complaints or objective findings which may persist, or any new manifestation which may subsequently appear.

The practical failure of the various modifications to which gastroenterostomy has been subjected in the hope of making it reliable, are directly attributable to this state of affairs. For a while it seemed that unilateral exclusion of the pylorus was the wanted addition; but experience has shown that the various methods of occlusion proposed and practised, either do not exclude, or when they do, become associated with new conditions which are very frequently liable to cause disturbances distressing to the patient both from their own manifestations and from the added impediment, which they furnish, if the gastroenterostomy should, for some reason, contract to too small a calibre for the adequate emptying of the stomach.

In recent years the dissatisfaction with these measures has caused a diametrically opposite swing of opinion, and "radical" operations are, more and more, being talked of which, essentially, include direct attacks on the lesion itself by a thorough removal of the ulcer-bearing area either by local excision of the stomach or duodenal wall, or by a "block" resection of the pyloric end of the stomach. With increased practice and experience the relatively large mortality, which had, at first, followed these radical operations, has been reduced, and while it is still larger than that which follows a simple gastroenterostomy, the added danger has seemed justifiable of acceptance by the more experienced men because of the greater reliability of the more permanent result, because of the obviation of certain annoying and dangerous complications, such as hemorrhage, and because of the prevention of the possibility of the retention of any carcinomatous structure.

The methods of excision, more in detail, are, in general, one of three:

(1) The local area surrounding and containing the lesion is removed by knife or cautery and the resulting defect is closed in such a way as to obviate, if possible, any resultant deformity of the stomach. Anywhere in the stomach the procedure is very easily done, but it is usually found that sufficient disturbance of gastric motor function results as to cause considerable distress to the patient. These annoyances can be almost entirely removed by doing gastroenterostomy; and the general practice, now-a-days, is to do both of these procedures simultaneously. (2) Lesions near, or at, the middle segment of the stomach, especially those on the lesser curvature and posterior wall, lend themselves quite readily to a sleeve resection, and the functional results are quite superior to those following a V-shaped resection of the ulcer-bearing area; so much so, that no further operation is necessary despite the fact that considerable deformation of the stomach follows this type of operation. The method has, however, never become very popular. (3) The third method includes the various forms of stomach resection—pylorectomy or partial gastrectomy after the essential types described by Billroth and Polya—these operations seem to yield the best results. In the duodenum excision of the ulcer-bearing area is, under certain conditions (*i.e.*, lesion located on the posterior wall near the papilla), not so readily accomplished; and when it can be done, plastic operations of the nature of Finney's pyloroplasty, or gastroenterostomy, are necessary to overcome the artificial narrowing of the lumen.

None of these various methods are ideal, however, and numerous recurrences of symptoms testify amply to the fact that the last word has not been said in the treatment of this malady, and account for the diligent efforts which are everywhere being made to improve the surgical method of therapy. We have come to the stage where both the medical and surgical man have each recognized the inadequacies of their particular field; a sensible viewpoint seems to be becoming prevalent whereby both are combining forces in the therapeutic management of the disease. As a general rule, this includes a preliminary attempt at medical cure, in which, if no other good be accomplished, the patient is brought into a more favorable and satisfactory condition for the employment of the middle step, the surgical operation. This latter, in the best hands, always includes, whenever it is possible so to do, the thorough removal of the ulcer-bearing area.

Operation ought, more and more, to be regarded as one of the incidents in the cure of the ulcer, the accomplishment of which may, and frequently does, necessitate further efforts; especially is it necessary to give much attention to the dietary regulations which are to be carried out for long periods of time after operation. These combined methods of treatment naturally result from the frequent necessity of treating post-operative symptoms in the operated cases. Just how the method works out in practice can be seen from the published report made by Richards.

The combined method treatment adopted by Richards embraced preliminary medical measures which included the control of the free acid and pain by alkalies and, in many instances, by belladonna, and a long course of dieting. Of the medically treated patients 40 per cent. returned later for operation. The mortality of the medical treatment was *nil*. The average time that the patients remained under medical treatment following the operation was three months. Eighty-five per cent. of the patients reported very satisfactory results from the combined method of treatment. Richards emphasized particularly that there had been gross neglect on the part of the surgeons doing stomach work in the matter of post-operative medical treatment.

It is well to realize that while whatever type of operation is done may be followed by a cure or by an extirpation of the ulcerations, yet post-operative symptoms may be many and distressing which are due to other causes. Most of the trouble met with after operation is caused by dietary indiscretions. Post-operative symptoms do not always indicate that organic lesions are present, and in many the disturbances are of a functional nature directly induced by manifold indiscretions in diet, or by the too rapid and early introduction of highly acid gastric contents into the jejunal portion of the alimentary canal. In cases with marked disturbances of the secretory and motor functions accompanying the ulcer prior to operation, the tone of the stomach is much disturbed, and while the immediate effects of operations are all that is to be desired, especially from the patient's point of view, very soon the effects of the pre-operative disturbances come to the surface again, to be the cause for greater or less distress until the normal condition is reached or, as more often happens, approximated.

Such functional disturbances are the causes for symptoms after operation in the greatest number of the cases. In a great number of them it is to be presumed that the original ulcer had healed and that no new ulceration has appeared. And yet, the operation—and I speak now especially of gastroenterostomy—has distorted the physiology to such an extent as to be cause for subjective symptoms. Such a state of affairs brings to one's mind the question whether, when these functional symptoms appear and persist, and when one assures one's self at operation that they are based on no organic lesion—whether it would not be wisest to cut away the jejunal loop and restore the normal continuity of the alimentary canal; it brings up for serious consideration the propriety of doing gastroenterostomy in certain selected cases intentionally as a temporary measure. This would be applicable to those cases in which resection by any of the methods in use was not possible; and the restitution would only be possible in those cases in which at the primary operation no handicap to the subsequent reestablishment of normal conditions had been introduced.

In considering all of the symptoms it is well to note that any type of operation which is done causes a distortion of the normal structure or

relations of the stomach and probably of the normal nervous mechanism controlling the normal physiology. Even when all of the wounds are surgically healed in a manner most acceptable in the present state of our knowledge, certain changes in the physiology are inevitable because of the abnormal anatomy and are, probably, prolific causes for the appearance of post-operative functional complaints. Whether these are to be permanent or temporary disturbances susceptible to spontaneous disappearance, is difficult of decision, but it seems that almost in all a definite change has taken place which necessitates a readjustment with, or without, the aid of medical men. The conception furnishes a ready explanation of the good results which usually follow a gastroenterostomy for cicatricial pyloric stenosis; here an abnormality existing over a long period of time has caused a disturbed physiology and has gradually and efficiently prepared the organ for some new point of egress; our operation includes no new departure from this preparation, but merely assists nature in the compensatory adjustment of the initial condition and the result follows quickly with a minimum of post-operative symptoms.

In a small minority of the operated cases organic lesions are causes for the post-operative symptoms. Besides those with mechanical obstructions at the points of egress from the stomach, there are the cases of persisting or recurring ulcers, or of newly formed ulcers in the general region of the stoma—the so-called gastrojejunal ulcers. The problem of the gastrojejunal ulcer is most important and particularly baffling. For, whereas in the ordinary varieties of gastric and duodenal ulcer we have had nothing to do with the creation of the unhealable defect, in the gastrojejunal ulcers we have, ourselves, ploughed and planted the field upon which, later, the ulcers appear. The entire life history is open to us, but up to the present no success has followed the many attempts to elucidate the mystery. The various factors about which much is said as etiological causes for the secondary lesions must play an insignificant rôle; otherwise the number of gastrojejunal ulcers would far exceed the 2 or 3 per cent. of all the gastroenterostomies which are done.

Wright has pointed out the fact as noteworthy that there is an extraordinary preponderance of these secondary ulcerations in the male sex. In his cases the preliminary operations were as follows: Anterior gastroenterostomy, 38 cases; anterior gastroenterostomy with entero-anastomosis, 26 cases; anterior gastroenterostomy with entero-anastomosis in Y, 10 cases; posterior gastroenterostomy, 54 cases; posterior gastroenterostomy with entero-anastomosis, 3 cases; posterior gastroenterostomy with entero-anastomosis in Y, 5 cases; partial gastrectomy, 2 cases; not definitely stated, 7 cases. Evidently secondary ulcerations occur after all the ordinary types of operation.

Two types of gastrojejunal ulcer can be differentiated in accordance with the location of the lesion: (1) The defect located at the site of the anastomosis and usually ascribed to some fault in technic, such as the

failure to cast off promptly some unabsorbable suture material, or to the want of accurate apposition, or the occurrence of excessive marginal necrosis. (2) The jejunal ulcer located at some distance from the line of suture usually in the efferent loop.

Anatomically true gastrojejunal or jejunal ulcers resemble the ordinary types of chronic gastric ulcer. Frequently, however, they are comparatively small lesions. The so-called "suture ulcers" show no resemblance to the latter; their gross characteristics are those of a narrow channel through which a foreign body is being extruded from the stomach wall. The manifestations of such "suture ulcers" may, however, be out of all proportion to the relative insignificance of the anatomical lesion; very extensive hæmatemeses are known to occur.

The symptoms include pain, vomiting, hæmatemesis, local tenderness, rigidity and frequently a local swelling. Pain is a very prominent symptom. The evidence presented by the Röntgen-ray is of a purely corroborative nature and is sometimes misleading. The clinical pictures are fairly characteristic and are as follows:

(1) A reproduction of the original symptom-complex occurs within a short time after operation and the patients believe that the old ulcer has reappeared. Progression of the symptoms and lesion may be very rapid, or the symptoms and signs continue much the same as before the operation.

(2) The symptoms develop slowly and gradually a tumor forms in the upper abdomen. At operation one finds that a fairly large ulcer has formed, has undergone subacute perforation and has become surrounded by a large mass of indurated and adherent intestine and omentum. Such a condition is best treated by jejunostomy.

(3) A tumor forms as in the previous group; suppuration occurs within it and the abscess ruptures into an adherent hollow viscus. Perforation into the colon gives a definite complex—rapid and extreme emaciation, diarrhoea of the lenteric type, vomiting of fecal matter or eructations of gas with a fecal odor. The latter usually occurs after a posterior gastroenterostomy. After an anterior gastroenterostomy the swelling tends to adhere to the anterior abdominal wall; an external fistula may result (Wright). Perforation into the free peritoneal cavity gives the usual symptoms.

MARGINAL, GASTROJEJUNAL OR PEPTIC ULCER SUBSEQUENT TO GASTROENTEROSTOMY *

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ADMITTED that the most frequent cause in recent years of the marginal gastrojejunal, recurring or peptic ulcer, so-called, following gastroenterostomy has been, and still is, ascribed to the use of non-absorbable material, silk or Pagenstecher, yet one must look further when the evidences of this type of ulcer are found in patients in whom nothing but absorbable material was used. Such ulcers are found frequently enough, but fortunately in a relatively small percentage when compared with the numbers of gastroenterostomies done for whatever cause or lesion.

One cannot entirely exclude the trauma produced by the varieties of clamps used in apposing the stomach and jejunum, nor the trauma produced by clamps such as the Allis, etc., in grasping and holding cut edges of either gastric or intestinal flaps. That the clamps of apposition and exclusion of leakage are causative in instances, I am quite convinced by personal observation of badly applied clamps, clamps of too rigid blades, and clamps too tightly locked; so that in any one of these instances, crushing of the mucosa and other layers may and does occur. Tearing of the mucosa and stripping off of patches by the rough application of Kocher, Allis, etc., types of clamps, used to hold in apposition or position the flaps, are readily accomplished. These contusions, abrasions, lacerations and strippings are without question a basement foundation for ulcer formation.

A few years ago, while operating upon a perforated ulcer of the duodenum, I excised the area involved and had a pathological examination made. The result rather astounded me, as a report of specific (syphilitic) evidence was returned. Four other excised areas of perforated ulcers of this portion of the intestinal tract were returned, two with syphilitic evidence and two without, making a total of three out of five. Such results, therefore, force one to include in the list of causations of gastrojejunal, recurring or peptic ulcer the question of syphilis as a probable strong factor.

Heat as a factor in causation must be accepted in this type of ulcer as much as it can be in the production of the usual site duodenal ulcer (see Mayo), as hot foods and drink impelled by gastric peristalsis are forced against certain portions of the walls entering into the gastroenterostomy.

Bearing upon this thought of situation of peptic ulcer, in the series

* Read before the New York Surgical Society, January 12, 1921.

quoted in this article, the usual position was in the posterior wall of the stomach near the opening, or its posterior edge, in the lower portion of the jejunal surface of anastomosis, and in that portion of the jejunum distal to the anastomosis, *i.e.*, in the normal course of the jejunal peristalsis. Nor can we overlook the great possibilities in chemical changes as to the hyperacidity, etc., being a marked factor.

I am inclined to believe, as a result of findings in several patients of my own, that a personal idiosyncrasy exists in reproduction, or let me definitely say, production. An Italian, in whom I did a Billroth No. 2, all with absorbable catgut, for a suspected malignancy of the pylorus and duodenum, the specimen of which was reported by the pathologist as a benign duodenal ulcer with infiltration into the pyloric antrum, complained of almost the same symptoms fourteen months after operation, but with pain of a distinctly more severe character and extending toward the hypogastrium, well toward the pubes. Alkalies and food gave relief for months. Then, begging for relief, he was opened by me again and an area of ulceration and induration was found in the gastric wall, three-fourths of an inch posterior to the edge of the opening. A transgastric incision was made, and feeling that the original pathological diagnosis was incorrect and that now a malignancy metastatic with ulceration existed, I cauterized the area and then sutured the ulcer edges through the transgastric opening. About one month of relief followed and then all manifestations of the period previous were so far intensified that resection with grave outlook was accepted.

A wide resection of the ulcer was made, a section of jejunum over five inches long involved in the anastomosis was resected, a jejunostomy and subsequent gastroenterostomy were made. Recovery was without a thrill. Recurrence of symptoms appeared in eight months. There was a reoperation by another attending for adhesions and a cholecystectomy with no ulcer found. In this instance all dietary precautions had been taken.

The second patient in the reported series returned months after operation with aggravated symptoms, and deflected pain in almost the same zone as complained of by the patient mentioned above. He underwent prolonged treatment by gastric specialists and finally reoperation was resorted to. An ulcer was found on the posterior wall of the jejunum fully one and one-half inches long and one inch wide, densely infiltrated, extending well down in the distal portion of the jejunum. Excision of the ulcer, jejuno-jejunostomy and revision of the gastroenterostomy were done. Relief was prompt; recovery perfect. Recurrence of symptoms was reported within eight months, with the patient evidently in the hands of another set of gastric and surgical specialists.

These two cases have so impressed me with the idiosyncrasy idea that I am led to include so indefinite a causative factor in my list until some more plausible one be assigned, unless we accept the broad state-

ment that the cause of the original ulcer is not removed by our gastroenterostomies, treatments and dietary.

That the ever present bacillus or coccus must be given its due weight has not been forgotten in the causations—if the original ulcer was produced by a bacillus or coccus conveyance, then the recurrent or peptic ulcer must also receive full bacterial causation weight.

Symptoms.—These are very much allied to the manifestations of the ordinary duodenal ulcer with an added intensity, particularly in the evidences of after-eating distress, this often being described as very painful, and is reflected downward toward the pubes and lower left quadrant. After a short time relief by food and alkalies is negative. The patient fears to eat, as the distress is so great, and therefore a more evident loss of weight is present than in the ordinary duodenal ulcer. Painful spots on pressure may be elicited in the epigastrium, but not more so than in the duodenal type.

X-ray so far has not been satisfactory in interpreting the secondary ulcer. In but one of this series was there a suspicion of residue or barium in a new zone, and this opinion was based largely upon the pre-X-ray diagnosis of peptic ulcer, made by close observation and by the taking of a careful history.

Prophylaxis.—Avoiding all causative factors, beginning with a careful blood analysis for lues. The non-use of clamps when possible, the proper application of forceps and appliances used in preventing leakage and soiling; careful handling of the flaps when instruments are used for such purpose; the use of absorbable suture material throughout the anastomosis; the suturing of the mucosa of the stomach and jejunum in a separate layer producing a direct edge-to-edge apposition as in a skin suture and thereby aiding in a primary union of apposed mucous membranes and then the final layers, instead of the through-and-through suture employed by many, I feel may have a great influence in preventing this lesion.

Proper dietary directions and the seeing that these are carried out; the avoidance of hot drinks and foods, etc.; regulations of business, as the great nerve strains of some of our professions and occupations are well-known factors in exciting exaggerated disturbances when an ulcer is present—all these should be given proper attention.

Treatment of suspected marginal peptic, gastrojejunal or post-operative ulcer is essentially that of the primary disease. A fair medical test with failure should be followed by prompt surgical attention. Upon opening the abdomen the original site is inspected for a continuance of the old lesion or new areas of involvement; then the gastroenterostomy area should be given a very careful inspection, all adhesions about should be fully liberated and careful palpation for induration and excoriation made. The appearance of the involved area in this type of ulcer is very much the same as in the area involved in the original ulcer. The stip-

pling effect is very characteristic. The examining finger palpating the site of the anastomosis meets with an infiltrated area and may also palpate the crater-like eroded ulcer.

In the event of finding suspicious or positive evidences, the anastomosis must be revised, the ulcer thoroughly excised, and a new anastomosis completed. Except in the event of the original ulcer having healed and no stenosis exists in the duodenum, after excising the ulcer at the site of the anastomosis, one should, I feel, produce a condition of normalcy by obliterating entirely the gastroenterostomy. This I was able to do in Case No. XII. In addition, if the appendix and gall-bladder are still present and there is any reason to suspect either of being causatives of infection, these should be removed. Recently I have been doing the Horsely operation in all patients in whom it is feasible, in the hope that this type of operation will be of more positive cure with less risk of secondary ulcer formation.

Appended is a list of some of the patients in whom I have revised the primary operation for this condition, at the Post-Graduate Hospital and one sanitarium, during the past five years:

CASE I.—I. S., July 24, 1917. Diagnosis: Gastrojejunal ulcer. Operation: Gastroenterostomy; removal of a linen thread; suture. Findings: Misplaced stoma. Revision; recovery. X-ray diagnosis: periduodenal adhesions.

CASE II.—I. S. (same as above), October 26, 1917. Diagnosis: Ulcer at the site of the old gastroenterostomy. Operation: New gastroenterostomy made; cauterization of the ulcer; another thread found. No X-ray report this time.

CASE III.—M. C., August 2, 1918. Diagnosis: Peptic or gastrojejunal ulcer, opposite the site of the stoma, in the jejunum. Former operation done eight months previous. Operation: Resection of the ulcer; revision of the gastroenterostomy; with recovery. X-ray diagnosis: New ulcer (?), speck of residue remaining.

CASE IV.—I. S., December 13, 1918. Two previous operations (as recorded above in No. 1 and No. 2). Diagnosis: Gastric ulcer at site of old gastroenterostomy. Operation: Resection of another ulcer, with revision of gastroenterostomy. Recovery. X-ray diagnosis: Negative.

CASE V.—L. G., February 20, 1919. Had been operated upon three times within a short period at one of the hospitals in the city, the first operation being June, 1917. Diagnosis: Stenosed stoma, after gastroenterostomy, with ulcer. Operation: Enlargement of the stoma, resection of the ulcer.

CASE VI.—L. K., November 28, 1919. Diagnosis: Ulcer following gastroenterostomy ten months preceding. Operative diagnosis: Misplaced stoma, ulcer in the edge of the stoma. Operation: Closure of the old gastroenterostomy, excision of the ulcer, new gastroenterostomy to normal site.

CASE VII.—M. H., August 20, 1920. Diagnosis: Gastrojejunal ulcer—date not given for the performance of the gastroenterostomy. Operation: Dissection of adhesions, revision of the gastroenterostomy, resection of the ulcer.

CASE VIII.—J. S., September 27, 1920. Previous operation by me eight years before. Present operative diagnosis: Peptic ulcer of the gastric border of the stoma following gastroenterostomy. Operation: Resection of the ulcer, revision of the gastroenterostomy.

CASE IX.—Italian: M., aged fifty years. Admitted to my service November 19, 1913. Operation December 5, 1913. Diagnosis: Duodenal ulcer; question of malignancy on account of the massive infiltration. Operation: Pylorectomy, posterior gastroenterostomy—all done with catgut. Early discharge, cured. Readmitted February 15, 1915, X-ray diagnosis: Patent stoma, nothing else. Discharged February 21, 1915. Readmitted March 16, 1916. Operation next day. Operative findings: Peptic ulcer, finger's breadth back from the margin on the posterior stomach wall, the size of a ten-cent piece. Transgastric cauterization and suture of the ulcer area. Readmitted April 4, 1916. Exquisite suffering—patient demanding operative relief. Operation: Resection of five inches of the jejunum and of the entire gastroenterostomy margin, including the ulcer, end-to-end anastomosis of the jejunum, gastrojejunostomy. Discharged within sixteen days in excellent condition. Readmitted March 8, 1919. Operation on another service. Diagnosis: Subperiosteal abscess of the maxilla; perigastric adhesions; chronic cholecystitis. Operation: Freeing of adhesions; cholecystectomy.

CASE X.—S. K., operated upon for a duodenal ulcer two years before, because of pronounced symptoms, exquisite pain, etc. Operation, done at a private sanitarium, revealed a large peptic ulcer in the jejunum, fully one and one-half inches long by one inch wide, in the distal margin of the opening, extending well into the otherwise normal intestine. Resection of this portion of the gut, reanastomosis, with revision of the gastroenterostomy. Cured. Symptoms recurring within the course of twelve to fourteen months.

CASE XI.—F. M. A most interesting case is that of F. M., aged thirty-one years. When I saw him on November 21, 1915, he gave a history briefly as follows: Alcoholic habits marked; mastoid operation July, 1913; returned from a European trip December, 1913; worked until May, 1914, when he observed that his stomach had gone bad. In fact, close questioning produced the typical symptoms of a duodenal ulcer, for which he was operated upon in one of our hospitals in this city. A pylorectomy for duodenal ulcer was done, with a *supposed* typical posterior gastroenterostomy, just one year and two days before his seeing me, *i.e.*, November 19, 1914. With the exception of three weeks, he had been worse than before the operation.

On the day of his first examination by me he gave a history of awakening at from one to four in the morning with violent cramps and feeling very weak. When arising he ate breakfast, which

affected him least of all meals. Meals, as a rule, followed by fearful distress, distention, etc. Occasionally the distress did not begin before 11 A.M. Vomited readily. Dinners distressed him fearfully—necessitating the taking of Na. B. C., etc. Loss of weight was more than usual in such cases. He was up two hours, the night previous to seeing me, with unbearable cramps in left side and down over the bladder. Vomited only bile and mucus.

Patient went to Rochester, Minnesota, in August, 1919, where he received conflicting opinions and advice, but was definitely advised that he was neurotic, that he should go to work and quit nursing an idea. He returned east, had his teeth all fixed, and thought there was some improvement in his condition. The improvement was due to taking only soft foods. Again said his pain was all on the left side—the entire left side—and at 1 to 4 A.M. he was relieved by taking food and occasionally Na. B. C. Again requested operation.

Examination revealed plus, plus sensitiveness to abdominal palpation, chiefly in left side; some visible (?) peristalsis, not definite. I advised exploration. This was not accepted, as the parents were much opposed to further operation.

On November 13, 1915, he returned, stating that no pylorotomy was done, but later operation revealed that this was done, an appendectomy also. On June 18, 1917, in the eighteen or twenty months since first seeing this patient, he had led a life of misery and suffering to such a degree as to cause him to express the desire to commit suicide. During these two years he had been in all the accredited and non-accredited gastro-intestinal institutions from the Atlantic to the Pacific coast, and also all the retreats for "Worn Out To Be Rebuilt" that the elusive and seductive advertisements can reach. On two other occasions besides that of November 13, 1915, I advised exploration. Finally, in his suicidal determination, he grasped at the exploration suggestion, and upon June 18, 1917, during our war activities, he was operated upon by me at the Post-Graduate Hospital, requesting: "Get me in shape as fast as you can so that I can be of some service to the country."

Operation (June 18, 1917).—A sharp angulation of the transverse colon was found with its apex attached to the site of the gastroenterostomy, with an area of thickening and stippling at the stoma margin. On attempting to release this colonic angulation it was observed that a communication existed between the colon, the stomach and duodenum. The opening in the colon was about the size of an ordinary lead pencil, an ulcer existing at the anastomosis, while the gastroenterostomy stoma was considerably contracted.

The opening in the colon was sutured, the marginal ulcer excised and the gastroenterostomy stoma revised. The patient had a slight infection of his skin wound. Discharged. Entered the service, was wounded in the thigh, and transferred to the tank service, where he developed a post-operative hernia. He continued until the armistice, returning with the rank of captain.

During all his recitals of his various travels previous to operation, he never gave a record of vomiting anything that resembled fecal or stercoraceous vomitus, but on post-operative cross-examination, he acknowledged that while in a very prominent gastrointestinal retreat in New York City, he had, on several occasions, vomited foul-smelling and tasting brownish fluid, that the attention of the doctors and nurses was called to the fact, but evidently no impression was made by it.

The last reports, during November of this year, three years following my revision operation, are those of excellent health.

Cases No. XII and No. XIII have been under observation during the week of December 12th to 19th.

CASE XII.—L., patient operated upon by me in February of this year. Excision of an ulcer on the anterior superior surface of the first portion of the duodenum revealed a contact or kissing ulcer on the opposite wall. This also was excised, and fearing a marked stenosis, a gastroenterostomy was added. Five months after operation the patient complained of almost the same symptoms. In the course of sixty days his condition was such as to warrant my reopening him and the patient himself asked for operative relief.

This was done December 17, 1920. On exposing the duodenal zone, I was surprised to find an unusually wide duodenum; in fact, wider than the usual. There was no evidence of a new ulcer and only a faint scar; while opposite the anastomosis in the jejunum an ulcer with deep walls and about the size of a dime was demonstrable. The ulcer was excised, the openings in the stomach and jejunum closed, with so far a perfect result.

Case XIII is a further interesting record of Case VI. Last operation of three or four in New York was done by me at the Post-Graduate Hospital, November 28, 1919. It consisted of a revision of the former operation, with excision of an ulcer and repair of a ventral hernia. There was relief until January or February of this year; in April he went to Rochester, Minn., and on April 8, 1920, was operated upon again. Relief for about two months followed. Patient returned to this city. On December 17, 1920, I was asked to take care of him, as he was bleeding from an ulcer. Up to date, December 24th, he has had three hemorrhages. The operating surgeon at the Mayo Institution stated that another gastroenterostomy was performed with repair of a ventral hernia.

GASTROENTEROSTOMY IN ACUTE PERFORATED ULCER OF THE STOMACH AND DUODENUM*

BY JOHN B. DEEVER, M.D.

AND

DAMON B. PFEIFFER, M.D.

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It is but a few years since the surgeon first began to save from certain death the victims of that most dramatic of acute abdominal seizures, perforated ulcer of the stomach and duodenum. Yet most of the points concerning its treatment can already be regarded as settled.

All success is based on early treatment. Better an early operation by an indifferent surgeon than a late operation by a master. The second essential is efficient suture of the opening. Successes are occasionally reported by other means such as tamponade, drainage to the ulcer site, omental plugs, the use of an adjacent structure as an occlusive patch, or the suture of a tube into the opening to form an external fistula. Such makeshifts are more apt to succeed in gastric than in duodenal ulcer, but in both they are accompanied by prohibitive mortality and in no sense and under no circumstances do they rival direct closure. I have never failed to effect a direct closure by suture and can scarcely picture a case of perforation into the free abdominal cavity in which the surgeon who is familiar with the exposure, mobilization and suture of viscera could find it impossible to close a spontaneous perforation.

So far do these two fundamental principles of treatment transcend all others in importance that contributions bearing on other points in the procedure must occupy a distinctly subordinate place. Nevertheless, such considerations are important and the judgment with which they are employed will be reflected in mortality percentage.

I have never felt it was wise to advocate the excision of perforated ulcers, though there are many early cases in which, doubtless, the operation could be performed with great safety. Rösing and certain Swedish surgeons have reported excellent results and a very low mortality in selected cases. In only one instance have I felt justified in removing the ulcer by partial gastrectomy, and this was in the case of a patient who perforated while in the ward awaiting operation, so that to all intents and purposes it could be treated as a clean case. The lesion was a large callous ulcer of the lesser curvature near the pylorus with a history of fourteen years' duration. It seemed a suitable case surgically and pathologically for excision, and the fact that it had just perforated

* Read at a Joint Meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, December 8, 1920.

spontaneously was not allowed to influence the decision to remove it. The patient recovered, though it was evident that the shock of perforation appreciably added to the strain of the operation which ordinarily is not productive of shock. In general surgeons are agreed that excision of acute perforated ulcer, as ordinarily seen a few hours after its occurrence, offers nothing of immediate life-saving value to compensate for the added time and trauma of the operation.

However, concerning simultaneous gastrojejunostomy in the treatment of perforated ulcer there is as yet no general agreement. The arguments pro and con have become rather familiar to most of us and are largely theoretical. Statistics of results which have been offered in favor of one or the other contention have been very confusing for the reason that early operation and skilful closure of the perforation so overshadow every other consideration that it is difficult to draw conclusions concerning the advantages or disadvantages of adjuvant procedures. Still it is our belief that experience will eventually point out the best method and to this end reports of individual results are still desirable.

It is now about fifteen years since we adopted the primary posterior gastrojejunostomy as a feature of the operation for acute perforated ulcers of the stomach or duodenum. Since that time in my service in the Lankenau Hospital of Philadelphia, sixty-seven acute perforated ulcers of the stomach or duodenum have been operated upon with five deaths, a mortality of 7.5 per cent. The earlier cases have been reported previously on several occasions. During the time of the preparation of this paper, owing to temporary conditions obtaining in the record room of the hospital incident to expansion of space and clerical force, a number of the earlier records have been unobtainable. We have therefore based the statistical study of this paper on the last fifty-five cases, among which there were four deaths.

It is remarkable that there was but one female to fifty-four males in this series. In Philadelphia perforating ulcer in the female is a rare occurrence, the proportion being much below that of the clinics in the British Isles and European countries. Seventeen ulcers were gastric, including the one female, and thirty-eight were duodenal. Eighty per cent. of the cases occurred between the ages of twenty-five and forty-five years, and the decade of greatest incidence was the fourth, which contained 40 per cent. of the total number. The ages ranged from twenty years to sixty-one years.

This series confirms the many able descriptions of the clinical picture and diagnostic features of the condition. A history of previous indigestion is common. In approximately one-half the cases (28) there was a clear history of gastric disturbance of ulcer type preceding the perforation. Approximately one-quarter (14) gave a history of previous indigestion of slight, occasional, or non-distinctive character, while the remaining quarter (13) gave no history or such a vague history of indi-

gestion that no importance could be attached to it. It is still worth noting for the benefit of those who lay stress on bleeding as a sign of ulcer that hæmatemesis and melæna were each encountered but twice in the previous history of the entire series. The duration of gastric disturbance before perforation varied from two weeks to thirty-two years. Perforation may be said to have been the first symptom in about 20 per cent. Of the cases whose symptoms should have apprised the attending physician of the existence of organic abdominal disease, but few (4) perforated within the first year of symptoms. Twenty-eight cases (51 per cent.) perforated during the first eight years of symptoms, being quite evenly distributed throughout that period.

Excruciating pain marking the moment of perforation, followed promptly by abdominal rigidity so marked as to merit the common term "board-like" were the distinguishing diagnostic features. Initial vomiting almost always occurred, but was not invariable. Tenderness paralleled rigidity, being most marked over the most rigid area. The greatest rigidity was usually in the epigastric region, though as time went on the lower abdomen, particularly the right side, became quite as spastic as the upper zone.

The amount of initial shock is difficult to determine, as the patient is rarely seen in the first throes of the seizure. There is reason to believe that a certain amount of shock is common immediately following perforation, but at the time the patient was first seen, true shock was not present. It was not uncommon for a patient to exhibit pallor and the facial expression of desperate illness, but it was seldom that the apathy, rapid feeble pulse, and low blood-pressure which characterize true shock were observed. Often reaction had occurred, the temperature, pulse and respiration were but little disturbed, and the diagnosis depended chiefly upon the history and the abdominal signs. Attention has repeatedly been drawn to this so-called latent period in perforating ulcers.

On admission the temperature range in this series was from 96° to 100.4°, the average being 98.2°. The pulse varied from 64 to 152, average being 92, and the respiration from 20 to 40, average 31. The average temperature, pulse and respiration, therefore, were 98.2°—92—31. This is remarkably little variation from the normal for a condition so soon to show its lethal character and is a common cause of error for the unwary practitioner.

The leucocytes varied from 2900 to 25,750 per cu. mm., averaging 13,700. In the few fatal cases the count was below 10,000 in each, being respectively 4500, 4800, 9600 and 9600 per cu. mm. The polynuclear percentages in these five cases were 53 per cent., 62 per cent., 78 per cent., and 77 per cent., respectively. It would seem, therefore, that a low leucocyte count with a low percentage of polynuclears is a bad diagnostic sign though exceptions occur, as shown by the remarkably low count of 2900

in a successful case and seven other cases in which the count was below 10,000.

Concerning the important factor of time elapsed before operation, the following table is explanatory:

Time Elapsed	1-6 hrs.	6-12 hrs.	12-24 hrs.	24-72.	Unknown.
Lived	25	12	5	4	6
Died	1	2	1	0	0

This table shows the ascending trend of mortality with the increase of elapsed time before operation, which has been so well emphasized by Moynihan, Caird, Walker and others. During this same period seven other patients with perforation were admitted to the hospital in a moribund condition and died without operation. Were these patients added to the above table the difference in mortality in the last group would be more striking and the combined medical and surgical mortality of the entire series of seventy-four patients would be twelve, or 16 per cent. It is not our practice either to refuse a chance to a patient or to waste the resources of surgery upon the dying, which we regard as a species of maltreatment to the patient that reacts upon surgery to its discredit. Nothing so impresses the lesson of the disastrous consequences of delay as refusal to operate and thereby cover the error.

The operations performed are as follows:

	Gastric Perforations			Duodenal Perforations		
	Recovered	Died	Mort. Per Cent.	Recovered	Died	Mort. Per Cent.
Suture and post gastro- jejunostomy	9	1	11.1	33	2	6
Suture only	5	1	20	3	0	0
Pylorotomy	1	0	00	0	0	00

The appendix was removed in twenty-one cases and the gall-bladder in two. Both cases in which cholecystectomy was added recovered, as did all appendectomies except one. The appendix is frequently diseased in these cases, as is well known, and I observed, about a year ago, a fatal case of appendicitis which developed in a young man upon whom a successful operation for perforated duodenal ulcer had been performed by another surgeon some months previously.

A glance at these figures shows that there is no evident discrepancy in immediate results that could be attributed to the performance or non-performance of the primary gastrojejunostomy. The mortality of 20 per cent. in the group treated by suture only, as compared with 7 per cent. in the series where anastomosis was made, carries no conviction, because of the small number of cases treated by suture only and the further fact that four of these cases were so treated because they were obviously bad operative risks. The remaining five cases treated by suture only were operated upon by others in my service who were less inclined formerly to add gastroenterostomy to suture. On the other hand, it must not be

supposed that all forty-two recovered cases in whom gastroenterostomy and often appendectomy, and in two cases cholecystectomy, were added were first-class operative risks according to usual standards. They averaged about eight hours from the time of perforation. They showed the typical clinical picture of acute perforation. The majority presented an extensive peritonitis with much fluid exudate. Often the perforation was large and there had been escape of food particles. The only characteristic in common that was remarked was that they behaved well on the operating table so far as respiration, aëration and circulation were concerned. It is a general rule that it is bad judgment in any operative procedure to prolong surgery after a patient shows signs of embarrassment of these vital functions. This applies to perforated ulcer surgery with equal force, but I cannot see that it has much bearing upon the advisability or inadvisability of primary gastroenterostomy, for if anything can be demonstrated by experience such a series as this shows that the operation *can* be done with safety if the surgeon uses surgical judgment in selecting his cases, and, more than that, it demonstrates that the operation is practicable in the vast majority of cases.

That an operation is practicable is in itself no good and sufficient reason for doing it. Our reasons are that we believe it gives a lower primary mortality and a better outlook for the future.

Consider the following facts with respect to the immediate mortality which is the feature chiefly stressed by the opponents of primary gastroenterostomy on the ground that it unduly prolongs the operation and spreads infection. Of the entire sixty-seven cases in the series fifty-five had the simultaneous anastomosis with three deaths, mortality 5.5 per cent. Of the twelve cases that had no gastroenterostomy, two died, mortality 17 per cent. But it may be urged that these series were selected in such a manner as to throw the heavier mortality in the latter group. In a measure this is true, but as we have no parallel series operated upon by simple closure let us take the results of those who are satisfied with the simpler procedure. Struthers reports the largest series, ninety cases with twenty deaths, a mortality of 22.2 per cent. The report is too brief to show definitely the type of operation in all cases, but Struthers in common with the Edinburgh School rejects gastroenterostomy as a primary operation, except for stenosis. Murphy in England reports twenty-eight cases of ruptured gastric ulcer in soldiers, treated by suture only, with two deaths: mortality 7.1 per cent. This is an excellent showing, but it must be remembered that he was operating upon a selected group of good physical subjects, and with very few exceptions his cases were brought to operation in the early hours after perforation. No end-results are given.

Gibson, in 1916, reported fourteen cases similarly treated with one death; mortality 7.1 per cent.

Walker reported from the Boston City Hospital ninety-eight cases

with twenty-one deaths; mortality 26.9 per cent.; almost all these cases were treated by simple suture.

Alexander reported thirty cases with nine deaths, a general mortality of 30 per cent. Ten of these cases were treated by enterorrhaphy and posterior gastrojejunostomy without a death, the nine fatalities occurring in the cases treated by simple suture. In spite of this record, Alexander concludes that gastroenterostomy is unnecessary because he could see no differences in the after-results of the two types of operation in the fourteen cases followed.

Richardson reported ninety perforations in the Massachusetts General Hospital with thirty-two deaths; 35.5 per cent. mortality. Only twelve cases were subjected to primary gastroenterostomy, of whom two died; mortality 17 per cent. In spite of the lower mortality Richardson condemns primary gastroenterostomy, saying that these were selected cases. He then states that these two deaths were due in one case to diabetic coma and in the other to delirium tremens which somewhat impairs his statement as to selection.

Many other series may be instanced but no point would be served. To offset those who have had favorable runs of cases by simple closure I may say that at one time I had over thirty consecutive cases treated by closure plus primary gastroenterostomy without a death.

In short, we are certain that the mortality of acute perforated ulcer is not increased by simultaneous gastroenterostomy provided it is done quickly, and not attempted in cases obviously shocked. We have, moreover, a distinct impression that the operation has given a lower primary mortality not only in the hands of those who use it routinely, but with those who employ it only occasionally for more narrow indications, and then explain their lowered mortality by saying that it was done only in selected cases.

There has been much talk on the subject of the dangers of infecting the lesser peritoneal cavity by opening the transverse mesocolon for the performance of gastroenterostomy. But no one seems able to report a case in which there is good reason to believe that this has occurred, and moreover, as we pointed out years ago, and since verified by others, much of the exudate that is poured out so richly in these cases is in reality sterile or relatively so, being a response to the chemical irritation of the gastric and duodenal contents rather than the result of bacterial inflammation. In this series there were thirty-four cultures of the fluid in the peritoneal cavity which were sterile in twenty-three cases and positive in only eleven.

Another point which has always seemed strange to us is the denial by the antagonists of the operation that gastroenterostomy possesses either a favorable early or late influence upon those patients admittedly the subject of the disease for which gastroenterostomy is acknowledged to be the cornerstone in treatment. A surgeon whose mind works in this

GASTROENTEROSTOMY IN PERFORATED ULCER OF STOMACH

peculiar fashion would never think of operating upon an ulcer in the pre-perforative stage by simple suture without gastroenterostomy. Yet the moment a spontaneous perforation has occurred, however small or large and wherever situated, he feels that the ulcer has now demonstrated that it is on the high road to recovery provided it has not succeeded in giving the patient a fatal peritonitis. Much has been said about the favorable influence of perforation *per se* upon the healing of ulcer. Gibson blandly and epigrammatically remarks that he "considered it unwise to do a gastroenterostomy for a condition which is going to be cured anyhow." While that may have been his experience in a small consecutive group of cases, and although many have been struck with the fact that ulcers treated by inversion often give no further trouble, it is now becoming clear that perforation in itself is not a guarantee of cure. Gibson's experience that all ulcers are cured by perforation and simple suture must be exceptional. We are unable to report the end-results in the entire series, as many of our cases belong to the class that are exceedingly hard to follow and our follow-up system, being of recent organization, has been unable to find many of them. However, we have records of the later condition of twenty-one patients (40 per cent.).

	Good	End Results. Im- proved	Unim- proved.
Suture only	2	0	2
Suture and posterior gastroenterostomy	17	0	0

Of the twenty-one cases only two were unimproved and these were both cases in whom gastroenterostomy was omitted. In one case suture only of a duodenal ulcer was made because of the bad condition of the patient. After recovery he still had indigestion and returned three months later for gastroenterostomy. He left the hospital symptomatically relieved and no further report is available. The second case was one of perforation of the anterior wall of the stomach, in good condition at the time of operation. He was operated upon by one of the assistant surgeons who omitted the gastroenterostomy. After recovery he had persistence of digestive troubles and two years later was readmitted for perforation of the posterior wall of the stomach. This was sutured and a posterior gastrojejunostomy made, since which time, eighteen months ago, he has remained well and without gastric symptoms. Lewisohn has recently reported five cases of recurrent or persistent ulcer after suture of spontaneous perforation. Alexander followed fourteen cases of whom seven had been treated by suture only and an equal number by suture and posterior gastroenterostomy. He found only one case entirely well and this was treated by suture only. This experience is at the opposite pole from Gibson's results, who reported that all his cases of simple suture had remained well. In all such studies it is well to remember that, even before perforation, ulcers may give no evidence of their

presence or but the slightest symptoms in 20 per cent. of the cases, as in this series. Struthers reports 40 per cent. of his cases as having either no disturbance or only the mildest gastric troubles before perforation. It is not surprising, therefore, that many ulcers after closure give little or no evidence of their presence even though unhealed. The base and edges have been put at rest by inversion. Rest, restriction in diet, and medication have exercised a favorable influence. It is quite probable that healing occurs in some cases. However, that healing is not the uniform result is shown by the cases already reported and by the experience of Sullivan, Taylor, Field, Wise and many others. Even Eliot, strong antagonist of primary gastroenterostomy, has collected seventy-five cases in which there was evidence of ulcer symptoms or later complications, such as hemorrhage or perforation, which might have been prevented by gastroenterostomy. We have learned, it is true, that gastroenterostomy is not always successful in relieving ulcer symptoms or in preventing complications, but we consider that it has been abundantly demonstrated that it is successful in such a high percentage of cases that there is no longer any doubt of its specific effect. The same arguments that are urged against gastroenterostomy in perforated ulcer may be urged and are urged by some of our medical colleagues against this operation in the treatment of chronic ulcer.

To our minds there are only two arguments of special and one of general nature that need be considered against primary gastroenterostomy. The general argument is one that has not been urged but should, nevertheless, be taken into account; namely, the liability to gastrojejunal ulcer. It would indeed be sad if a case that would have recovered entirely with suture only were to be subjected to gastroenterostomy and thereby acquire a gastrojejunal ulcer. If we were to generalize upon our own experience we might claim that this does not occur in the gastroenterostomy made for perforating ulcer, for we have had no such experience, but it is unsafe to draw deductions from the experience of a single series. Petrèn has reported such a case. The possibility is to be recognized but the incidence must be low. Unless it be considered a contraindication to gastroenterostomy for chronic ulcer it cannot be employed against the operation for perforating ulcer when the advantages are similar.

The weighty arguments of special nature are:

(1) That the mortality in unskilled hands will be increased by the addition of gastroenterostomy. (2) That even in the best hands gastroenterostomy will certainly raise the death-rate when used in desperately sick cases, whether early or late. To both these assertions we agree. Unless the surgeon is able to make the anastomosis quickly and with irreproachable technic simple suture is the safer operation. But let us not cloud the situation by pretending that the patient so treated as an

emergency is as likely to remain free from ulcer symptoms or complications as if he had been given a gastroenterostomy as well.

Again, we repeat the statement made in the body of the paper, that it is not wise to insist upon making a gastroenterostomy in the presence of shock or evident systemic toxæmia. These cases are not numerous within the first twelve hours after perforation, but they do exist. The importance of gastroenterostomy as a primary procedure is not so great as to warrant accepting obviously increased operative risk. That it does not increase the primary mortality in properly selected cases we consider to have been demonstrated. On the contrary, there is good reason to believe that it promotes convalescence and actually diminishes mortality. Accumulating statistics and more accurate follow-up records are dispelling the fallacy that perforation cures ulcer and tend to show that primary gastroenterostomy lessens the likelihood of future ulcer symptoms and complications.

COMPARATIVE RESULTS OF PYLOROPLASTY AND OF GASTRO-ENTEROSTOMY IN STOMACH SURGERY*

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For a long time the leading internists have been criticising the results in gastric surgery. So many complaints from such a source should not be ignored. To be sure, we may very fairly come back with the retort that after medical treatment has failed, where surgery relieves 60 to 70 per cent. of these cases, the medical man has little ground for criticism.

In a recent article by Bastedo, of Columbia University, he makes the startling statement that "in our own practice ulcer cases that have had one or more operations come for treatment almost as frequently as ulcer cases that have not been operated." This seems to be an extreme assertion, but when we ask almost any internist of his experiences he voices the same sentiment. Smithies, out of 226 cases of gastroenterostomy operations for gastric and duodenal ulcers traced, reports only fifty-seven, 20.9 per cent., were clinically free of complaints. It leads one to ask if the operative results in this field are good enough to satisfy the composite surgical conscience.

As the results now stand, from 15 to 40 per cent. of the operations done for gastric ulcers are failures. At least they do not restore the patient to sound health. There has been a tendency to explain the imperfect results on the ground that the operation was ill advised and the technic faulty. Moynihan asserts that many of the poor results following gastroenterostomy have been due to: (1) Operation done in the absence of any organic lesions justifying it; (2) in cases of chronic extragastric lesions that have been overlooked; (3) incomplete operation, the ulcer not having been dealt with; and (4) various defects in technic.

I am willing to concede that many of the failures are avoidable, but even with these surgical errors eliminated, numerous cases report for treatment with symptoms little improved, or as bad or worse than before the operation. The stubborn fact is that there are many disappointing results following gastroenterostomies done by the best surgeons following the most approved methods.

Wilensky, speaking of the current operations for ulcer, says: "None of these methods are ideal, however, and numerous recurrences of symptoms testify amply to the fact that the last word has not been said in the treatment of ulcer, and account for the diligent efforts which are everywhere being made to improve the surgical method of therapy for gastric and duodenal ulcer." Robert Hutchinson concluded that: "Gastroenter-

* Read before the Western Surgical Association, December 4, 1920.

ostomy profoundly affects the gastric functions, both secretory and motor, and it is not the simple drainage procedure sometimes pictured."

When one stops to analyze the revolutionary changes in the physiology of the stomach which follow a gastroenterostomy, the operation usually practised in gastric and duodenal ulcer, one is not surprised at these statements from such eminent authorities.

Normally the food, when it enters the stomach, is subjected to a very thorough grinding and mixing with the gastric juice, and, as stated by Howell: "There is a certain orderliness in the movements of the stomach, and especially in the separation and ejection of the more liquid from the solid parts, which shows the existence of a specially adapted mechanism." Chymification is complete before the closed pyloric sphincter permits its entrance into the pylorus.

As soon as the acid chyme enters the duodenum the prosecretin is transformed into secretin and the pancreatic secretion begins. Then by the process of "rhythmic segmentation," so vividly described by Cannon and Blake, the duodenum, by means of vigorous churning movements, brings the bile and pancreatic ferments into intimate contact with every particle of the chyme before it is permitted to pass onward into the jejunum. This thorough contact is necessary to insure complete digestion.

When a gastroenterostomy opening is made, if it functions as the operator desires it to do, a revolutionary change in the physiology of digestion takes place. When one considers the coarse boluses of food, imperfectly charged with gastric juice, which are propelled through the artificial stoma into a jejunum unprepared for such treatment, and with no special mechanism for mixing the food boluses with the bile and pancreatic juice, one wonders that gastroenterostomized patients get along as well as they do. That such a radical upsetting of the normal mechanism does not always produce disaster speaks volumes for the adaptability of the human digestive function.

Bayliss and Starling proved that when they isolated a loop of jejunum by cutting off the nerve supply and ligated both ends of the loop, and then injected 10 c.c. of a 0.4 per cent. solution of HCl, pancreatic secretion promptly began. But Bayliss and Starling and Wertheimer and Lapage showed that the greater the distance from the pylorus the acid entered the intestine the less pronounced the effect, and the scantier the pancreatic secretion. It is fair to conclude that to get the best functional activity of the pancreas the abundant secretin formed by the presence of the acid chyme in the duodenum is necessary, and that when the gastric juice enters the intestine lower down the normal physiological activity of the pancreas is somewhat impaired.

Entire satisfaction with any operation can never be obtained till the failures and disappointments are reduced to a minimum. The poor results following gastroenterostomies have too often, it seems to me, been set down as due to faulty technic, to having been done in the absence of

organic lesions justifying the operation, to incorrect diagnosis, etc., and apparently without considering that there may be some inherent fault in gastroenterostomy, bound to be followed by many poor results, no matter how carefully the case is chosen nor how technically perfect the operation.

Moynihan, while believing that many bad results follow ill-advised and technically imperfect operations, frankly admits that other cases, done according to the best light we have at the present time, have some very unpleasant sequelæ. He sums up the prevailing symptoms complained of by these uncured patients as pain, vomiting, hemorrhage, and diarrhœa. Regarding these four symptoms it can be shown that any or all of them may and frequently are caused by altered physiology and by the stomach emptying at a point more or less remote from the general direction of the peristaltic wave, and entering the intestine at a point not physiologically adapted to the function thus forced upon it.

Pain.—Moorhead shows that the pain is sometimes due to forcible peristalsis against a closed pylorus. He has found in these cases the pyloric antrum is dilated and its muscular wall hypertrophied. Watching with the fluoroscope he has noted that at the exact moment a strong peristaltic wave has impinged against the pylorus the patient has experienced the exact type of pain for which he seeks relief. Pain is also due to recurrent or unhealed ulcers, also to the occurrence of jejunal ulcer, which, I believe, is much more frequent than usually supposed. Although often due, no doubt, to unabsorbable sutures, many cases have been reported where jejunal ulcer has followed gastroenterostomy when none but absorbable sutures have been used. A jejunal ulcer is a more serious lesion than that for which gastroenterostomy is usually done. Colic and intestinal soreness are a frequent result of the rapid entrance of coarse unchymified food into the jejunum. This material is usually highly acid, not having been neutralized by the alkaline bile and pancreatic juice.

Hemorrhage.—Most of the sources of hemorrhage will be the same regardless of the type of operation, but the one very frequent source, jejunal ulcer, is a direct result of gastroenterostomy.

Vomiting.—Obstruction, because of a kink of the efferent loop of the jejunum, was found by Cannon and Blake to be the most frequent cause of failure after gastroenterostomy. Vomiting from this cause is frequent, no matter who the operator nor how carefully he may seek to avoid this condition. Bile and pancreatic juice enter the stomach through the artificial stoma, and if the pylorus is patent more or less vomiting is likely to result from this cause. Improved technic has almost wholly overcome the acute early vicious circle which formerly cost so many lives, but it is impossible to get away from the fact that a vicious circle is often the cause of ill results, though it is not so deadly as when the long loop operation was in fashion. Reflex vomiting sometimes occurs as the

result of a severe colic produced by the rapid filling of the small intestine when the stomach empties too rapidly.

Diarrhœa.—This is a frequent result of gastroenterostomy and it is probably usually due to too rapid emptying of the stomach. The food that enters the jejunum is not well mixed with the gastric juice and little, if at all, with the bile and pancreatic juice. Normal digestion, under such conditions, is impossible, the food acting merely as a foreign body and an irritant to the intestinal mucosa. A resulting diarrhœa is the natural consequence. It is fair to say that the diarrhœa is probably beneficent since it gets rid of an irritating foreign element. Andrews and Mix have recently reported a case where the entire food taken passed directly through the stomach, via the gastroenterostomy stoma, without time for any action by the gastric juice. It was necessary to get an X-ray picture within thirty seconds of the time the opaque meal was ingested or they found the stomach empty. Doctor Andrews gave this condition the highly descriptive name of the "Dumping Stomach." Cramping of the bowels and what the patient called explosive bowel movements were complained of with general soreness over the abdomen and loss of weight.

Most of the symptoms that have been noted are due inherently to gastroenterostomy. They are the result of a disturbed physiological process. The act of digestion is one of the most important functions performed by the body, and it would be a great boon if it could be found possible to relieve the distressing symptoms of ulcers and stenoses by a less revolutionary procedure. Gastroenterostomy has saved thousands of lives and will continue to save lives in certain types of trouble, but it seems to me there are reasons without number why a more physiological method should be adopted in the treatment of many of these cases.

Given the bare physiological facts without any of the prejudices of past experience, there is not one among us who would not consider the rational manner of dealing with the problem would be excision or cauterization of the ulcer and enlarging of the natural outlet sufficiently to secure free unhindered emptying of the stomach.

It seems that the various operations introduced which allow emptying of the stomach contents directly into the duodenum have been condemned without due trial. Most of the surgeons who condemn pyloroplasty have done so without any experience or after a most meagre trial of the method and many times with all the signs of a prejudged decision.

Some eminent surgeons dismiss the subject with a few kind words that are really damning so far as their influence on others is concerned. For instance, Sir Berkely Moynihan says: "The operation of Finney and the operation of Kocher have, however, a distinct place in surgery, and it is by no means unlikely that in the future they will be performed in a certain class of cases for which gastroenterostomy is now the chosen method." Warbasse, speaking of the Finney operation, says:

"It is one of the most useful operations in surgery, and is destined to play a larger rôle than has yet been its lot." Doctor Binnie says: "Finney's operation is a most valuable contribution to surgery and in many cases it is a desirable substitute for gastroenterostomy."

Unfortunately most of the surgeons who speak so kindly of this operation go right on performing gastroenterostomies. That more do not resort to some form of pyloroplasty I believe is largely due to the fact that they are familiar with gastroenterostomy and because of a widespread but erroneous opinion that mobilization of the duodenum is extremely difficult and dangerous.

In proposing wider use of a more physiological operation for the various lesions for which gastroenterostomy is usually done I do not wish to plead for any one of the several admirable operations already well known. The Heineke-Mikulicz pyloroplasty, as usually described in the books, does not seem adequate. The opening made is too small to serve its purpose; but, as Mikulicz describes it, the procedure is more extensive. The incision is made on the stomach wall and duodenum far enough to make an adequate stoma.

The operation as done by Finney seems to meet all the requirements, and the size of the opening may be as small or large as seems necessary to meet the needs of the case. All that is necessary is to make an opening large enough to function easily after the narrowing which comes with the decrease in size of a dilated stomach. Finney and Friedenwald advise dealing with the duodenal or pyloric ulcer through the gastroduodenostomy incision, and consider "the opportunity thus afforded to explore digitally and inspect the ulcerated area and then excise it through this incision is one of the strongest points in favor of the operation." They report 100 cases with five deaths from the following causes: (1) Persistent vomiting associated with pregnancy; (2) atrophy of the liver; (3) broncho-pneumonia in six days; (4) shock; (5) chronic nephritis (uræmia). Eighty-two cases were traced to the end of the first year and the results in 93.6 per cent. were satisfactory. Can anyone make as good a showing from an equal number of gastroenterostomies?

There are bound to be some cases where the conditions are unfavorable for pyloroplasty. Dense massive adhesions about the pylorus and duodenum will render this operation inadvisable because of the difficulties and dangers and because post-operative obstruction would be probable. Finney also excludes the cases where great thickening and infiltration about the pylorus would make the operation inadvisable. They found in most of their cases having hyperchlorhydria before operation, that the acidity gradually lessened and a normal was reached on an average of about two months.

The operation devised by Horsley, of Richmond, for its simplicity, appeals to one, if further trial shows it to be permanent in its good results. It combines resection of the ulcer with pyloroplasty which

extends at least two inches into the stomach wall and one inch on the duodenum.

To recapitulate, the main objections to gastroenterostomy are: (1) Peristalsis carries the chyme past the gastroenterostomy opening forcibly against the pylorus, and whatever gets through the artificial stoma leaks through, following the law of least resistance. (2) The material that reaches the jejunum is much of it unprepared, chymification is incomplete, it is not yet thoroughly mixed with the gastric juice, and it is not intimately blended with the bile and pancreatic juice as is so perfectly done by the rhythmic segmentation which takes place in the duodenum. (3) Because of the facts just given, digestion is imperfect and incomplete, the intestinal mucosa is irritated and in many cases greatly inflamed, an abnormal amount of gas is present, and the patient suffers from colic, diarrhœa, and lowered nutrition. (4) Jejunal ulcer, a condition much worse than the original disease for which the operation was done, is a direct result in frequent instances of this unphysiological procedure. (5) The amount of secretin produced in the jejunum is less than normal and there is probably a subnormal amount of pancreatic secretion when all of the stomach contents enter directly into the jejunum. (6) A large meal completely filling the stomach will, as shown by Cannon and Blake, so stretch the stomach side of the gastroenterostomy stoma that the distal side of the jejunum will shut down against the opening like a lid and absolutely prevent stomach contents entering the jejunum.

Pyloroplasty or gastroenterostomy does not have these objections, but has the advantage of permitting the digestion to go on normally. The opening is in the regular highway of the peristaltic wave. Even when the sphincteric action of the pylorus is destroyed the rhythmic segmentation of the powerful duodenum will prevent the stomach from emptying too rapidly. Later, if the pyloroplasty has not been made too large, the pyloric sphincter will function to a certain degree on the same principle that the anal sphincter acts after it has been cut.

It seems to me that a great improvement in results will be obtained when a universally friendly coöperation is established between the internist and the surgeon. Too often a spirit of rivalry has entered in and the controversies have sometimes been a little acrimonious. In gastric and duodenal ulcers there is a distinct place for the internist and for the surgeon.

When one of these cases falls into the hands of an internist it would seem only fair for him to appreciate that this is a borderline case and call in a surgeon in order that the patient may have the advantage of both viewpoints; and the surgeon should not operate on one of these cases without the benefit of a good, clear-headed internist's advice and counsel.

Each case ought to be worked out carefully from all angles, a good anamnesis secured, the clinical symptoms weighed carefully, the physical signs gone into thoroughly, the chemical and X-ray findings consid-

ered in an unbiased manner, a Wassermann test made in every case, and the patient's general condition and resistance sized up as fully as possible. If further medical treatment is deemed advisable, always considering the welfare of the patient first, let that be done, and if the treatment succeeds, so much the better. If no benefit is derived from medical treatment or if the symptoms recur, surgery should have its innings. And when an operation is done it is a great comfort to have a friendly and resourceful internist at one's elbow and let the type of operation be worked out together.

When an operation on the stomach is begun it should stop short so far as the stomach is concerned unless real pathology is found. Failing to find the expected gastric or duodenal lesion a thorough survey of the intraabdominal viscera will often be rewarded by finding some unexpected pathology which explains the symptoms.

It is my opinion that active ulcers are better dealt with by excision or, better still, by cauterization, as so admirably worked out by Balfour. It is also important, when operating on ulcers, to find and remove the focus of infection from which the ulcers had their origin. The gall-bladder and appendix are always under suspicion and no operation is complete until these organs have been inspected carefully and removed unless normal.

One of the sins to which too many of us must plead guilty is operating on these patients and turning them loose. In these chronic cases the operation is only the first step in the cure. Every case should be treated carefully, medically and dietetically for months and often for years, before being considered cured in the sense that he may be permitted to go along and live and eat in his own way without medical guidance.

I am convinced that if these cases are systematically studied post-operatively from the standpoint of symptoms, chemistry, and X-ray findings, the knowledge gained will be illuminating. Many of the so-called successes will be disappointing, especially if the follow-up system is carried out over a series of years. That type of operation will be adopted in the final chapter that leaves the stomach mechanically and physiologically in the most normal condition.

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DRAINAGE OF THE COMMON BILE DUCT THROUGH THE CYSTIC DUCT: CYSTICO-CHOLEDOCHOSTOMY

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TWELVE months ago Doctor Halsted and I made a brief report at a meeting of the Medical Society of the Johns Hopkins Hospital on the subject of drainage of the common bile duct. Up to that time the ductus choledochus had in four instances been drained in the manner about to be described, two of the patients being exhibited at the meeting. In a letter to the editors of the *Journal of the American Medical Association* (published December 20, 1919, vol. lxxiii, pp. 1896 and 1897) Doctor Halsted advocated the careful and complete closure of the incision into the choledochus and the drainage of this duct by a tube passed well into it by way of the ductus cysticus. For this procedure he proposes the term cystico-choledochostomy, realizing, of course, that the choledochotomy is not embraced in it.

In our older hospital records we find that in a few instances a tube had been passed from the cystic into the common duct, but only in cases in which the common duct had not been incised. For example, in 1899, Doctor Halsted being able to remove stones from the common bile duct by forcing them back through the cystic duct drained the former by a tube passed through the latter. Similarly Sowers, in 1904, drained the common duct through the short stump of a friable cystic duct. Finney and Follis, also for the same obvious reason, drained the common duct in this manner in 1903 and 1904. In none of these cases, however, had the common duct been incised.

On March 24, 1917, Doctor Halsted first employed the method that we now advocate for all cases in which there is no definite contraindication. The patient, a woman fifty-six years old, was intensely jaundiced. After the removal of a shrunken, chronically inflamed gall-bladder containing stones, and of several large, soft stones through an incision into the greatly dilated common duct, there remained one rather large stone wedged in the mouth of the cystic duct. As this stone was not readily removed by instruments it was dislodged with the fingers of the operator, the little finger of the left hand being inserted into the dilated cystic duct and the right index finger into the common duct. On dislodgment of the stone the little finger slipped easily through the cystic into the common duct. A catheter, No. 19, French, was passed through the cystic into the common duct and retained by a suture of catgut, No. 00. The long incision in the common duct was carefully closed with two rows of interrupted

chromic catgut (No. 0) sutures. About this tube four small drains¹ were placed. The patient's convalescence was remarkably rapid. All of the drained bile came by way of the tube and thus could be accurately measured (Vid. Chart No. 3, Case I). On the fourth day the tube was clamped for eleven hours; on the fifth for a longer period. As the clamping caused the patient no distress, and as there was no peritubal leakage, the tube was removed on the sixth day. Except for a faint stain on the first dressing there was no evidence thereafter of even a drop of bile in the sinus tract. The wound healed promptly and the patient walked out from the hospital three weeks after admission. Thus for the first time in this clinic drainage of a sutured choledochus was maintained by a tube passed into it through the ductus cysticus. In the previous cases of cystico-choledochostomy the common duct, as stated above, was not incised, the stones having been removed through the cystic duct.

Although the impression made by this experience was a profound one, it was not until Doctor Halsted, two and a half years later, had been operated upon for stones in the common duct and experienced the distressing consequences of the loss of all the bile for a period of three weeks that he insisted upon the closure of the incision into the choledochus and the drainage of this duct by way of the cysticus whenever possible. He had, indeed, requested that this procedure be adopted in his case, but as the cystic duct entered the common duct from behind it was thought better, being simpler, to drain the choledochus in the orthodox fashion—in the way recommended and practiced by surgeons the world over. On the second day bile began to leak about the tube and after the fourth day the tube (removed on the fifth day) conveyed none of the bile which for three weeks poured in great quantity from the sinus. Food was positively repulsive, and the sense of taste was so far lost that frequently he seemed unable to distinguish one kind of food, meat or vegetable, from another except by sight. By the fourteenth day emaciation and weakness were so marked that grave concern for his life was felt. In three weeks he lost thirty pounds in weight.

The operation is performed as follows:

The cystic and common ducts being well exposed, the cystic artery ligated, the cystic duct clamped and divided about 2 cm. from

¹ The drains employed in this case are made as follows: A single layer of gauze of the required size is laid upon a piece of gutta-percha protective cut to a slightly larger size; the two are then rolled or folded up together, the gauze being on the outside and the protective projecting beyond it. The protective prevents granulations from penetrating the drain deeper than one layer of gauze. Drains of this kind are used, not infrequently, instead of the cigarette drains to guard against their possible displacement. Cigarette drains may, of course, be anchored by the gauze which projects from the ends, but Doctor Halsted believes that it may sometimes be better to have the protective project in order to avoid the adhesion of gauze to the line of suture in the common duct or to the tissues about or over the stitches. Drains such as above described are loosely anchored by adhesions throughout their length—everywhere except at their very tips.

its origin, the gall-bladder excised, the common duct incised, and all discoverable stones removed, a probe as large as possible should be passed into the duodenum. The stump of the cystic duct should then be investigated and, if advisable, stretched by a clamp or other instrument (Vid. Fig. 1). It is my preference to introduce the tube

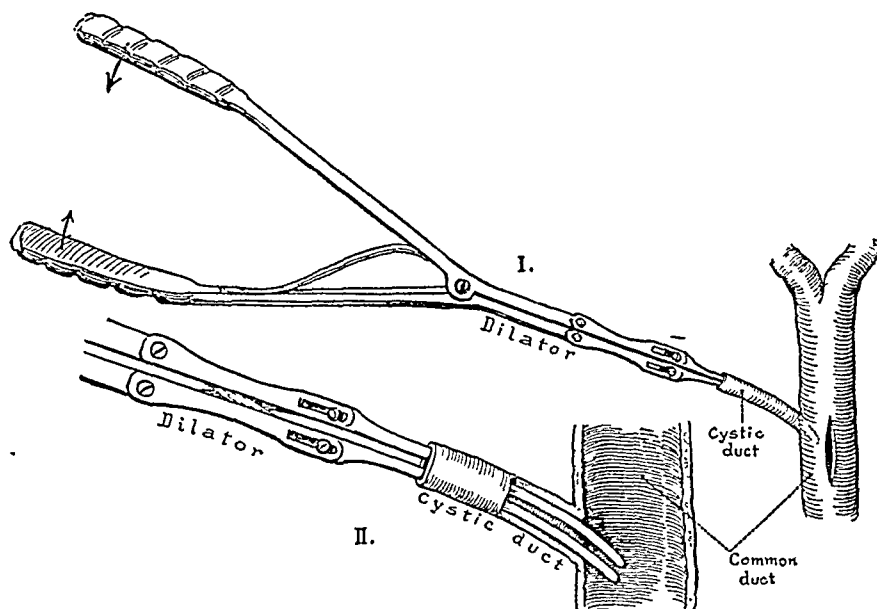


FIG. 1.—Showing a method of dilating the cystic duct.

of the selected size through the cystic into the common duct before suturing the incision into the latter (Vid. Fig. 2). The tube being

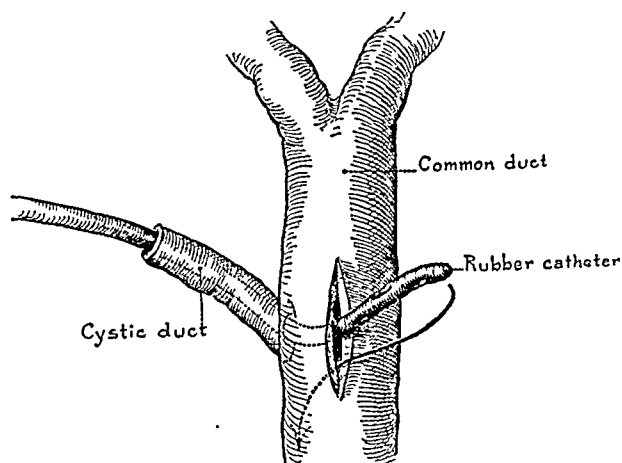


FIG. 2.—The small side openings are made in the catheter after it has been introduced through the cystic duct and pulled out of the opening in the common duct. It is then returned to the common duct and anchored to the cystic duct before the incision of the common duct is closed. In this way one assures the final position of the end of the catheter.

properly located, it is maintained in place by one stitch of catgut No. 00, passed through its side and into the wall of the cystic duct. The incision into the choledochus is closed by one or, preferably, two rows of interrupted fine silk (No. 0) sutures. I have several times

used the finest catgut (interrupted sutures) for the inner row. One should test the line of suture by injecting salt solution through the tube. The suture line may then be protected from the drains by overlaid fat or other tissue. Three or four very thin Halsted drains or slender cigarette² drains are placed about the rubber catheter. The cystic duct should be made to hug the catheter closely. It may ultimately seem advisable to employ a tube larger than we have been accustomed to use, but we must bear in mind the fact that the chief function of the tube is to relieve tension on the line of suture of the common duct until union of this wound is firm. The employment of the largest possible size of tube in the unjustified hope that perhaps a stone may escape through it is inadvisable. Although small concretions have occasionally been known to pass by way of a tube, it is more than probable that when this has occurred others

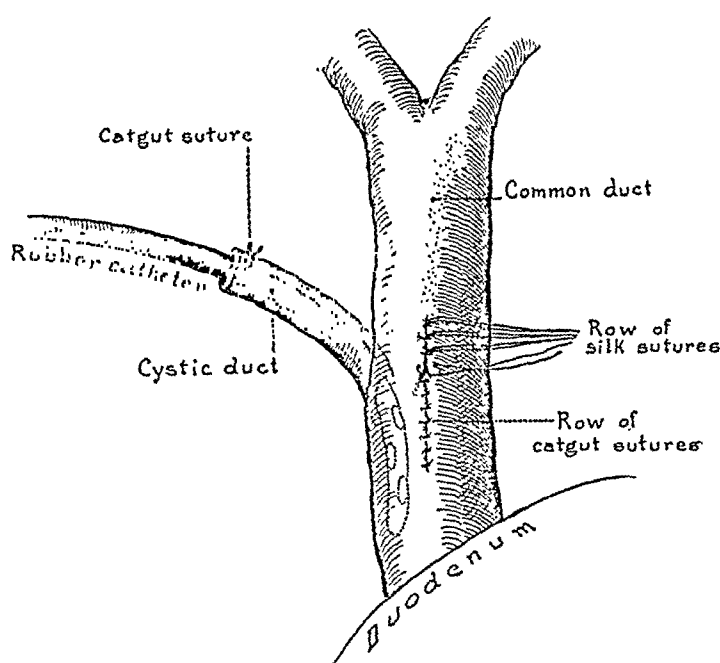


FIG. 3.—Cystico-choledochostomy completed except for the second row of sutures in the common duct.

were left to find their way into the duodenum by the natural route. In none of the experiments on suturing of the common duct made by Doctor Halsted and myself have we seen a suture making its way into the duct. The little knots of black silk were invariably found outside. Sutures may, conceivably, have been cast off into the lumen, but if so they had passed into the duodenum before the animal was sacrificed. In one of Doctor Halsted's dogs the wall of the duct was so far inverted as to produce intense jaundice for a number of days. When, on recovery, the dog's common duct was examined its lumen was at no point found to be narrowed.

The abdominal wound is closed, layerwise, by sutures of silk No. A (doubled for the rectus sheath) reinforced by two or three through-and-through stitches of silkworm gut. The drains are re-

² The cigarette drains were also devised by Doctor Halsted, who in the early eighties inaugurated the use of gutta-percha tissue (Vid. J. Am. M. Assn., 1913, lx, p. 1119).

moved, some on the second or third day, the remainder on the third, fourth or fifth day. The catheter in the duct should not be disturbed until there is reason to believe that the wound in the common duct is firmly healed. In one instance it was left, as an experiment, for three weeks. Observations of various kinds, detailed below, were made during this period. On removal of the tube the bile, except for a few cubic centimetres, passed by the natural route.

In case of obliteration of the cystic duct one should make, if feasible, a second opening in the choledochus, just large enough to admit a small tube, and completely close the original incision. I tested this in one case at Doctor Halsted's suggestion, and with satisfactory result. The outflow of bile ceased promptly on withdrawal of the tube (Vid. Fig. 4).

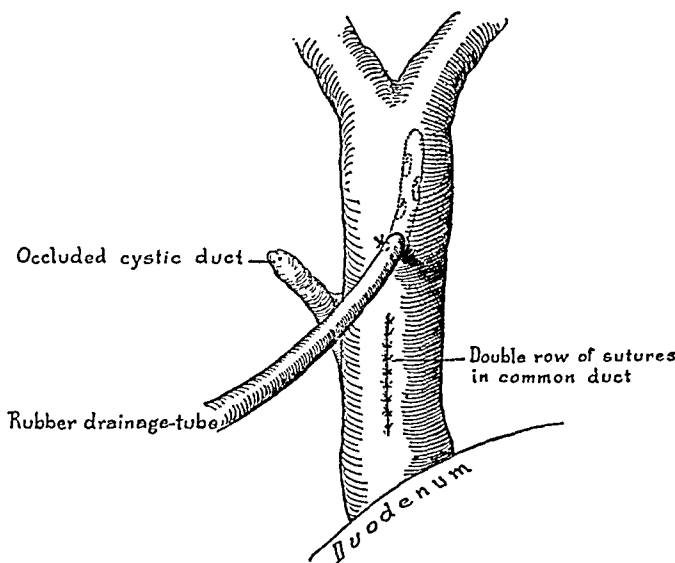


FIG. 4.—A method of avoiding the placing of a tube through the incision of the common duct when a cystico-choledochostomy cannot be done.

That the operation may occasionally be difficult or even impossible must be admitted. The obliteration of the cystic duct in one of my cases prevented its accomplishment. Whereas tubes passed through an incision into the common duct seem, as a rule, less liable to kink if they are passed upwards, towards the hilum of the liver, the natural direction for those introduced through the cystic duct seems to be downwards, towards the duodenum. In all of our cases the tube has been pointed towards Vater's diverticulum, and in none of these did it become kinked or obstructed. The curve of the tube is probably supported by the cystic duct and the under surface of the liver, so that I believe kinking is really less likely to occur than when the tube is directed upward through an incision in the common duct. There is great variation in the size of the cystic duct. When it is too small to admit a tube of the required size it should be dilated with either a fine clamp or special instrument (Vid. Fig. 1). I have found that it can be readily stretched. The tube which

we have usually employed has been a catheter, size No. 16 of the French scale, but a No. 12 suffices. The tube should be snugly embraced by the cystic duct which if too large should be reduced in size by a stitch or two. Occasionally one may have to split the duct for a short distance to facilitate the introduction of the stretcher.

The following four cases are cited to illustrate the value of this method of draining the common bile duct after choledochotomy.

CASE I.—Surg. No. 42375. Admitted March 22, 1917. Female, white, aged fifty-six years. For twenty years the patient suffered from indigestion; only for the past five months has she been jaundiced.

Examination.—Intense jaundice of a slightly greenish hue; stools clay colored; temperature normal; blood negative; systolic blood-pressure, 140; diastolic, 80; slight tenderness on deep pressure over the common duct; an indefinite mass in the region of the gall-bladder.

Operation (March 23rd, by Doctor Halsted).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The details of the operation have been given above.

No bile appeared in the wound after the removal of the tube; the abdominal incision was completely healed seventeen days after the operation. The daily drainage of bile is tabulated in Chart No. 3, Case I. *Bacillus coli* was the only organism found in the cultures.

CASE II.—Surg. No. 51586. Admitted July 29, 1920. Male, white, aged sixty-three years. In the seventy-five days preceding patient's admission to the hospital he had five attacks of chills, fever and severe, colicky pains; with each attack the jaundice deepened.

Operation (July 30, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. A large stone was wedged in the ampulla of the common duct. After dilating the cystic duct a catheter, No. 12, French, was passed through it into the common duct. The incision into the common duct was closed with two rows of interrupted sutures—the first of catgut, the second of silk.

There was no leakage at any time of bile about the tube which was removed on the sixth day; there was slight drainage of bile through the wound for two days (Chart No. 3, Case II). *Bacillus coli* was the only organism found in the cultures. The patient was discharged with the wound healed twenty-three days after the operation.

CASE III.—Surg. No. 52024. Admitted September 25, 1920. Female, white, aged forty years. Typical attacks of gall-stone colic associated with jaundice and fever began only two months before admission.

Examination.—Patient is deeply jaundiced. There are numerous skin abrasions, and furuncles, the result of scratching to relieve the itching.

Operation (September 29, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The gall-bladder and common duct were filled with stones. After excision of the

gall-bladder the common duct was incised and from it about thirty stones were removed. A No. 14 catheter was passed through the large cystic into the common duct. The lumen of the cystic duct had to be reduced to the size of the tube by the application of two silk sutures.

For the first two or three days the bile from the tube was thick and very dark. On the fifth day it appeared to be normal and the tube was then clamped for three hours. The occlusion of the tube was followed by pain and nausea. It was not clamped on the sixth day. On the seventh day the clamping of the tube produced no noticeable symptoms, and hence it was withdrawn. The drainage of bile externally ceased on the ninth day—two days after the withdrawal of the tube (Vid. Chart 3, Case III). For the seven days prior to the tube's removal the patient had no appetite and protested against efforts made to feed her. In addition to the anorexia there was marked lethargy. The appetite returned promptly on restoration of the bile to the intestine.

The wound was completely healed fifteen days after the operation, and the patient left the hospital on the twenty-third day.

CASE IV.—Surg. No. 52206. Admitted October 11, 1920. Female, white, aged forty-six years. Patient gave an indefinite history of pain in the region of the gall-bladder and of brief periods of jaundice during the six years prior to admission.

Operation (October 18, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The liver was found to extend far below the costal margin. A large pedunculated lobe overhung the gall-bladder. The narrow pedicle of this lobe consisted chiefly of dense, fibrous tissue. The constriction was manifestly due to tight lacing. A thickened gall-bladder bound by adhesions was excised. An exploratory incision was made into the common duct, but no stones were found. The cystic duct admitted a small probe and was easily dilated to accommodate the No. 12 catheter which was pushed through into the choledochus. The incision into the common duct was carefully closed with two rows of fine silk sutures, and the efficacy of the closure tested by injecting salt solution through the tube.

This patient had slight nausea and vomited occasionally for the first eight days. These symptoms were not accentuated by the clamping of the tube on the fifth, seventh and eighth days (Vid. Chart No. 3, Case IV). After the ninth day the tube was kept occluded most of the time until its removal on the nineteenth day. During all this period no bile escaped externally except by the tube. The tube was left undisturbed for this length of time to afford opportunity for observations on the rate of the flow of bile under various conditions and to note the bile pressures (Vid. Charts 1, 2 and 3).

The first recorded observation was made on the tenth day after operation when the patient had a good appetite and no discomforts and when all the bile was passing into the duodenum. In none of

our observations was the bile outflow continuous for more than a minute after the unclamping. During the interrupted flow three or more drops would follow closely and then, for a few seconds, there would be none. These observations seem to support the assumption that rhythmical waves of contraction, similar to those of the ureter, occur in the common bile duct.

In addition to the kymographic record of the dripping of bile from the tube we have observations (made by Doctor Webster) on the bile pressure (Vid. Chart No. 2). On the nineteenth day after the operation the tube in the cystic and common ducts was connected with a manometer. The "U" was filled to the level of the short arm with bile and this level, being approximately on the level with the common duct, was considered as being zero pressure.

Connection with the manometer was made at 8.15 P.M. The bile in the long arm of the "U" started rising immediately and by 8.20 had reached a height of 6 cm. and by 8.22 a height of 8.5 cm. This rise occurred stepwise, the pressure rising during the act of inspiration and remaining stationary or dropping back slightly with expiration. By 8.25 the pressure was 9.25 cm. During this time the patient was lying quietly relaxed, at one time only speaking a sentence of five words. The breathing was perfectly quiet. At 8.27 P.M. the pressure level was fluctuating between 9.5 and 9.75 cm., being highest at inspiration. Shortly after 8.27 the patient took a fairly deep sigh when the pressure rose to 10.25 cm. By 8.30 the pressure had dropped back to 9 cm. At this point we asked the patient to raise her arms to her head, whereupon the pressure rose to 9.5 cm. On putting both arms down by her side the pressure dropped to 8.5 cm., but soon rose to 9 cm., falling to 8 cm. by 8.33 P.M. The patient now was asked to move the left leg. This was followed by the bile pressure rising to 9.25 cm. The pressure remained at this level until 8.35 P.M. We then asked the patient to hold her breath for ten seconds; the pressure rose to 13.5 cm. and then went back to 7.75 cm. Upon holding the breath for twenty-five seconds the pressure rose to 16.5 cm. and then dropped to between 11 and 12 cm. At 8.37½ P.M. the patient spoke a few words; the pressure rose to 14 cm. At 8.40 P.M. the pressure began dropping by steps (going down on expiration and remaining at that level or rising slightly on inspiration) until it had reached 10 cm. Between 8.41 P.M. and 8.43 P.M. the pressure fluctuated between 8 cm. and 7.5 cm. When the patient yawned the pressure went at once to 10 cm. and dropped immediately to 6.5 cm. On holding her breath for fifteen seconds the pressure rose to 10 cm. and then dropped to 7 cm. Twenty seconds after this the patient held her breath for twenty seconds and the pressure rose to 10.5 cm. It then dropped to 7 cm., but on yawning it rose to 11 cm.

By pressing with the hand on the abdomen in the lower left quadrant the pressure rose in the manometer corresponding with the amount of pressure made on the abdomen. It was possible, with extreme pressure on the abdomen, to obtain a pressure in the manometer of 17.5 cm. (Vid. Chart No. 2).

Advantages of Cystico-choledochostomy.—(1) The incision into the common bile duct may be closed completely and with confidence that union by first intention will usually be secured. The presence of a tube led through an incision into an infected duct undoubtedly imperils the healing of that incision. In many such cases the wound of the duct probably breaks down throughout its entire length. With the opening of the incision into the choledochus the bile leaks about the tube. On extrusion or removal of the tube the bile drains through the abdominal wound until the opening in the duct becomes closed by granulation tissue or healing by second intention. In relatively young and healthy individuals the processes of repair may be rapid, and the loss of bile may be sustained occasionally for long periods without serious consequences. But in debilitated or old people the complete loss of bile may in a few weeks prove disastrous. Emaciation and weakness due to the loss of bile have presumably predisposed some of our patients to the pneumonias of which they died and have occasioned great distress to many of those who recovered.

(2) Healing of the abdominal wound and drainage tract is less likely to be delayed if uncomplicated by the leakage of bile—bile which is quite invariably infected.

(3) The period of bile drainage may be shortened by weeks. On the third or fourth day one might begin to test the effect of clamping the tube, but I believe it may be dangerous so early to expose the common duct sutures to the possible pressure from within the duct. In one case there was obstruction, presumably at the papilla, for five days. It would seem to be advisable to delay the clamping of the tube when the common duct is seriously infected.

The effect of the first occlusion of the drainage tube should be noted carefully. After one to three hours the patient may complain of pain and possibly vomit. We interpret these symptoms to mean that the bile is finding difficulty in passing into the duodenum and is collecting under pressure in the common duct: consequently we unclamp the tube. The release may be followed by a rather profuse flow of bile for a few minutes. Several brief trial occlusions of the tube may be necessary before evidence that the bile has made its way into the duodenum is furnished. When the occlusion of the tube is not followed by pain or gastric disturbance we assume that the flow of bile is unobstructed. In one case the tube was left in place for three weeks, the occlusion being maintained continuously for sixteen days, except for occasional brief interruptions to permit observations on the bile pressure and flow.

(4) Following removal of the cystico-choledochostomy tube there has been no leakage whatever of bile in more than half the cases, and no patient has drained externally a significant amount of bile for more than two days.

CYSTICO-CHOLEDOCHOSTOMY

(5) When there is a serious infection of the bile ducts it might seem advisable to embrace the opportunity which the snugly fitting tube affords to irrigate the ducts with very mild antiseptic solutions.

(6) The technic of cystico-choledochostomy or some modification of it may afford a means of releasing gradually the bile pressure in the biliary apparatus.³

SUMMARY

1. Prolonged leakage of bile is distressing in its consequences to those who withstand it and has occasionally, both directly and indirectly, been responsible for the death of the patient.

2. The incision into the common duct should be closed and the tension on the suture line be relieved by a tube passed through the cystic duct.

3. This tube, if properly fitted, may function for weeks, conveying the bile, without peritubal leakage, to the surface.

4. On removal of the tube the discharge of bile through the fistula ceases either immediately or within a day or two, provided the common duct is not obstructed.

5. The patency of the duct may and should be tested by clamping the tube.

³ I have frequently observed that the drainage of the common bile duct of deeply jaundiced patients is followed by a serious toxic state characterized by listlessness, normal or subnormal temperature, and a tendency to sleep. In an extreme case it may be difficult to arouse the patient. I have not seen this toxic state in non-jaundiced patients, and it would seem, therefore, to be due not merely to the loss of bile, but rather to the effect of the release of the bile pressure. The same effects have been noted when deeply jaundiced patients were relieved of their bile pressure by anastomosing the gall-bladder to the stomach or intestine.

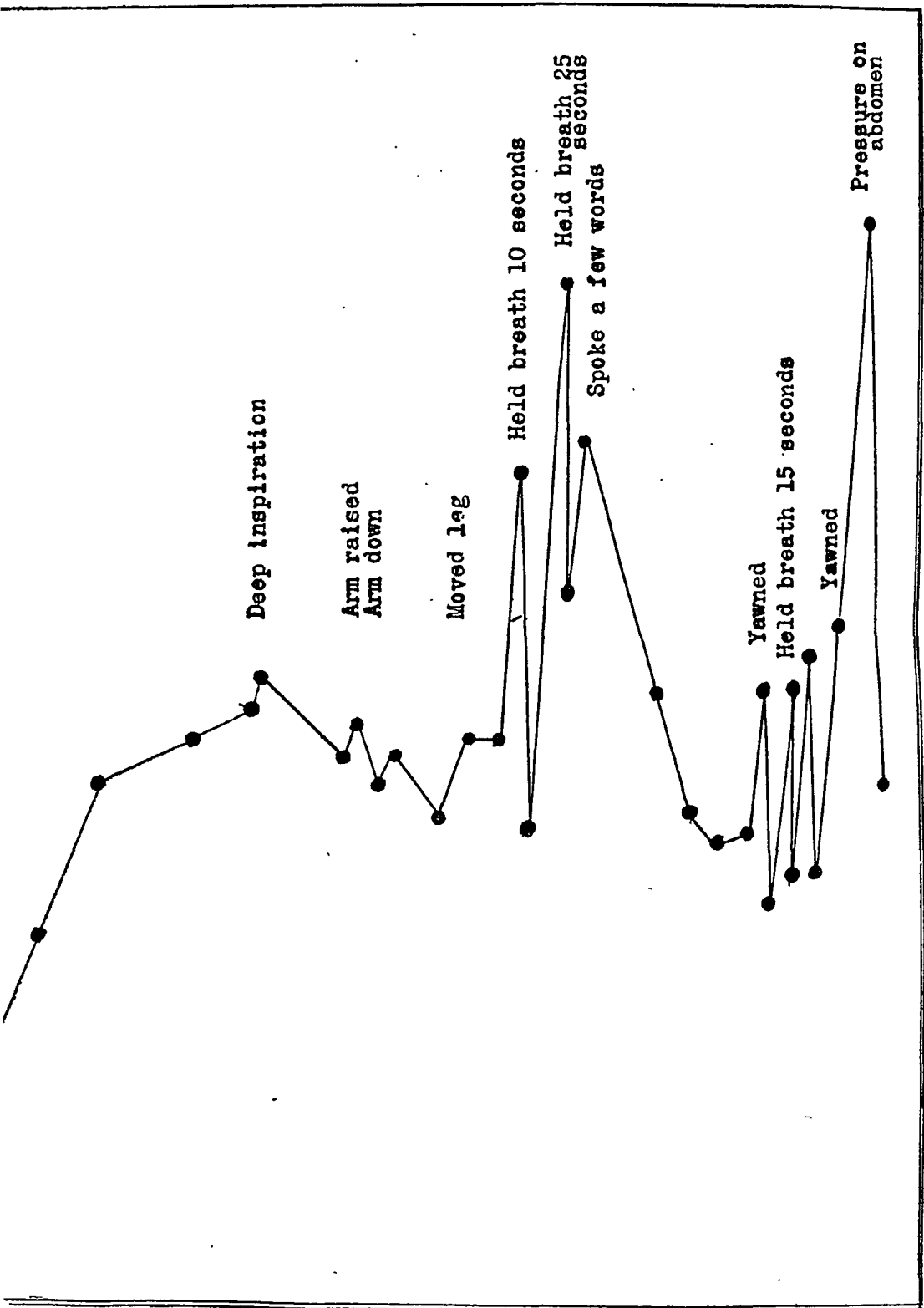


CHART 2. CASE IV.—OBSERVATIONS ON THE BILE PRESSURE. PRESSURE RECORDED IN CENTIMETRES OF APPARENTLY NORMAL BILE

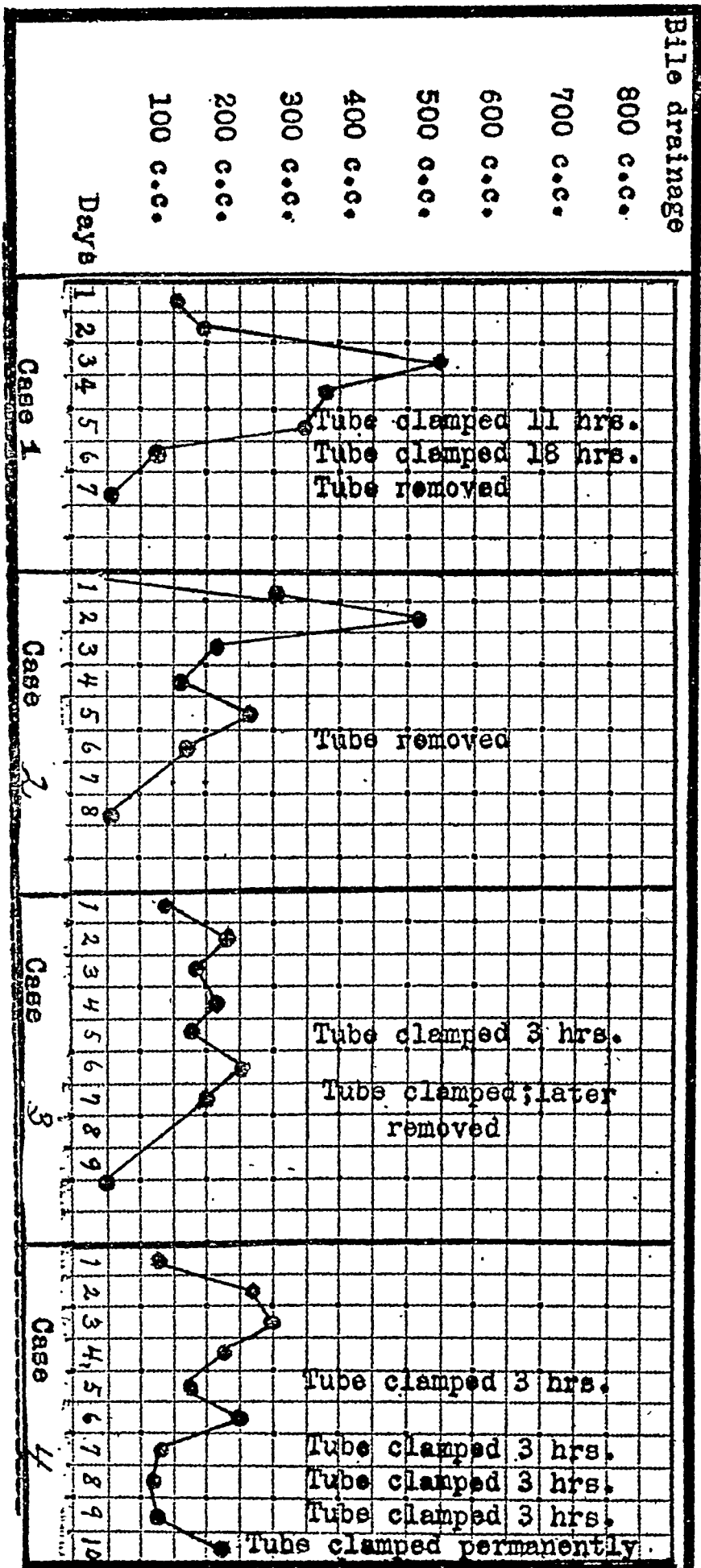
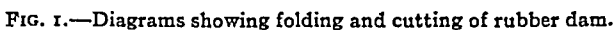


CHART No. 3.—BILE DRAINAGE CHARTED FOR THE FOUR CASES REPORTED IN THIS PAPER

Case No. I was unaffected by the clamping of the tube, and there was no leakage of bile after its removal. In Case II preliminary clamping of the tube was not done. After its removal on the sixth day some bile drained from the wound for two days. In Case III the clamping of the tube on the fifth day for three hours was followed by pain and vomiting. Its removal on the seventh day was followed by a little leakage of bile for two days. In Case IV it is questionable whether some nausea and vomiting on the fifth, seventh and eighth days have any relation to the clamping of the tube, for they were present before this was done. On the ninth day there were no symptoms either before or after the clamping. On the tenth day the tube was clamped, and remained so, except for short periods (Vid. Chart 1), until the twentieth day, when the tube was withdrawn. There was no leakage of bile after its removal.

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I have employed this device for over twenty years. The use of dental



I have modified the Mikulicz tampon by making the outer enveloping layer out of dental rubber dam. A square of rubber dam of suitable size, say 20

THE RUBBER DAM MIKULICZ TAMPON

by 20 inches in the case of a large retrocecal appendiceal abscess, is folded two or three times in the form of a cornucopia. The apex, which will eventually be the lowest point of the dam, is snipped off, making the hole the size of the little finger. An inch and a half above this the edges of the cornucopia are cut out, making a perforation about one-half inch in size (Figs. 1 and 2). In some cases a second row of perforations is cut about one inch higher up. The tampon is then introduced as follows:

After the appendix has been removed and the cavity sponged out of all purulent material and blood, the operator carries the tampon into the cavity,

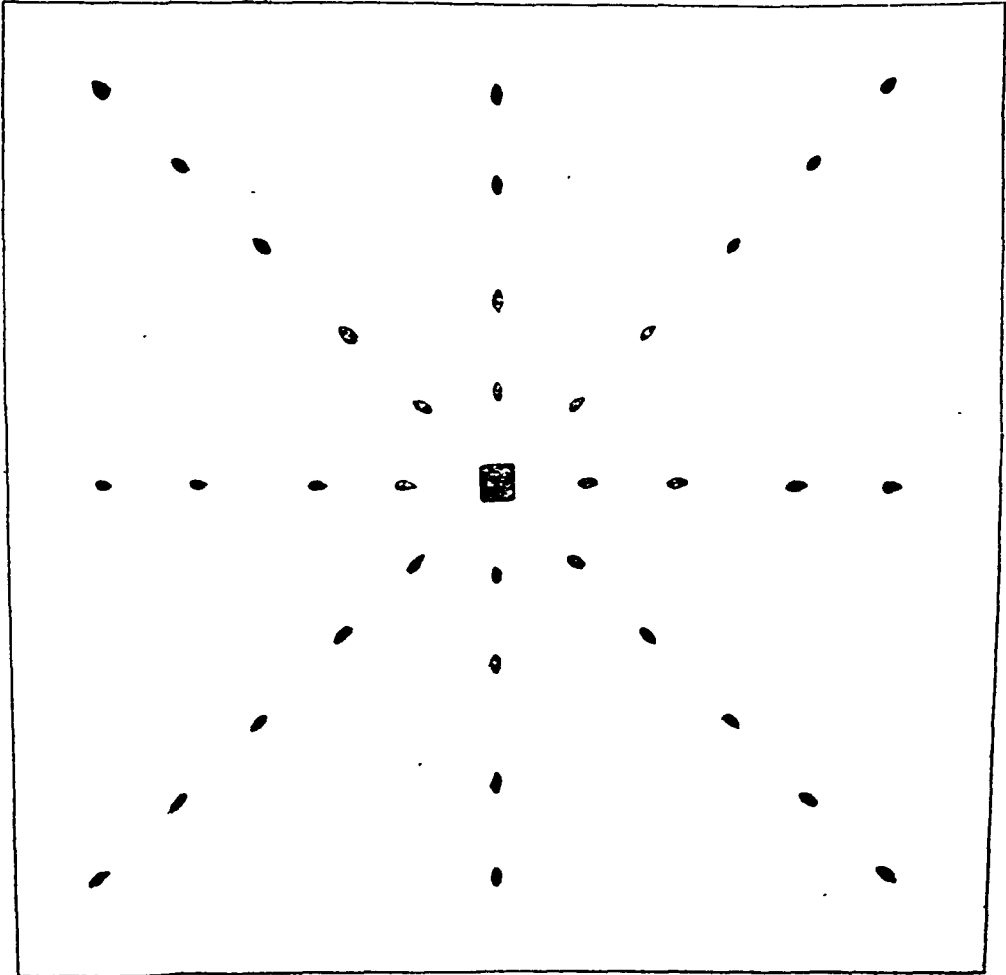


FIG. 2.—Showing distribution of holes.

the index finger being placed at its apex (Fig. 3). The pads and retractors are still in place. The edges of the rubber dam are spread out and while the operator still keeps his finger on the apex, the tampon is filled with strips of packing. I generally "overstuff" the cavity in order to push the omentum and gut well away from the incision in the abdominal wall (Figs. 4 and 5). A large loose dressing is applied. At the end of twenty-four hours the outer dressing is removed. The tampon is usually not disturbed that day, although the gauze packing may be partially withdrawn in order to allow a little better drainage by loosening the dressing. At the end of another forty-eight hours the gauze is all removed. Then one of two things may be done; either the

tampon is also removed or it is left in place and a small amount of fresh gauze reintroduced. At the end of seventy-two hours the original tampon should be entirely removed. By that time the rubber dam will have become quite smelly.

At this period one of the principal advantages of using the tampon will have been obtained; namely, the permanent pushing back of the abdominal contents from the wound cavity, and there is now left a well-defined, walled-off cavity which can be drained with great ease. There is, moreover, no longer need for the free "wide-open" drainage, and the cavity can be drained by inserting a small piece of rubber dam folded on itself two or three times. This piece of rubber dam is generally removed in the course of a day or two, and the Carrel-Dakin treatment instituted under ideal conditions.

An abscess treated as described above drains in a marvellous fashion. The fluid readily escapes both alongside the rubber dam and by capillary drainage through the loosely packed gauze. The intraabdominal contents are kept back with a minimum of trauma and irritation. The removal of the gauze and the tampon itself is absolutely painless, a factor to which I attach the highest importance.

In cases of a large neglected abscess it is my custom to rely largely upon this large tampon and not use any sutures in the abdominal wall. Sutures in the abdominal wall have two disadvantages: (1) Stitch holes are likely to become infected and be of themselves a complication, and (2) by locking up of the fascial planes, which are likely to become infected, secondary infection of the abdominal wall with necrosis of the fascia and sloughing may occur.

By the omission of sutures and reliance on the tampon, we have for the most part a wound which has absolutely no reaction and is absolutely painless. In fact, we have the impression that the convalescence of patients treated in this way is very much more comfortable than by other methods.

As the wound closes the abdominal walls can come together over the abdominal contents; that is, these, having been held back at the outset, will not intrude into the wound as a wedge. We are under the impression that these wounds do not give rise to so bad herniæ as do wounds drained in the usual fashion.

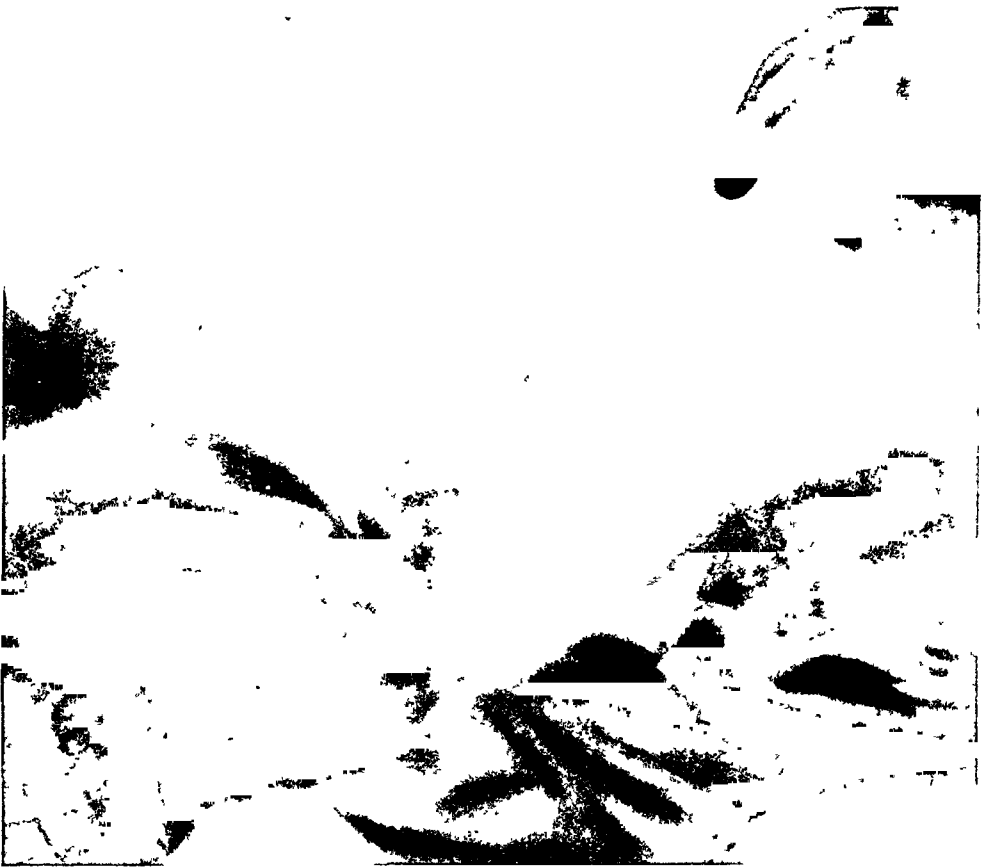


FIG. 3.—Method of introduction of tampon.

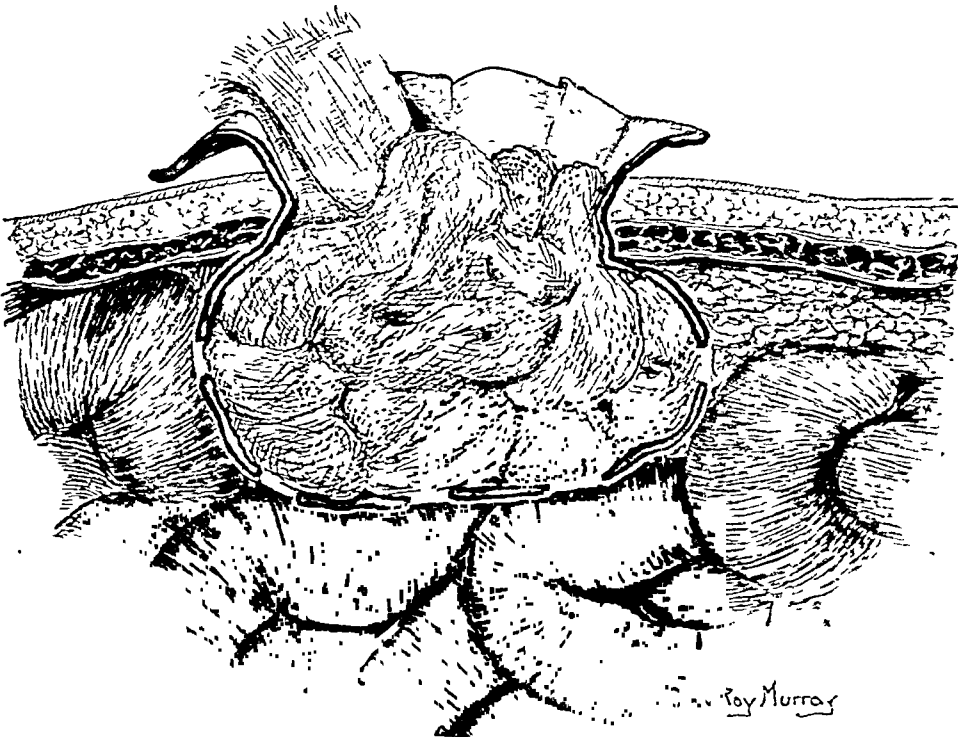


FIG. 4.—Rubber dam Mikulicz tampon.



FIG. 5.—Modified tampon in situ.

THE GIBSON-MIKULICZ TAMPON IN ACUTE APPENDICITIS*

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THE subject of drainage in acute inflammatory processes is, and always has been, vigorously debated. In no field is this more true than in acute appendicitis. Men of great experience and skill in abdominal surgery differ to the widest extremes in this respect. Some never drain unless forced to, and then only with the smallest possible material through a counter-opening; others use rubber tubes, glass tubes, large cigarette drains, etc.; a few pack the wound wide open with gauze.

Aside from the question of weak scar, intraperitoneal adhesions, and slow healing, few would object to leaving these infected wounds wide open. This is the rational and accepted procedure in other parts of the body and would unquestionably be used here except for these three objections.

The peritoneum has such marked resisting power to infection that great liberties may be taken with it in certain cases, a fact which explains the excellent results of our more radical confrères. There is, however, a sharp limit in this direction, and all of us now agree, I believe, that certain types of appendicitis require drainage. The question of which cases to drain and the means to employ are still subject to debate.

On the Cornell Division of the New York Hospital, in the service of Dr. Charles L. Gibson, it has been the custom not to drain when the stump of the appendix could be inverted or securely ligated and when there was little or no extension of the inflammation beyond the appendix proper. A moderate amount of turbid serum is not a positive indication for drainage. However, any odor to the exudate makes drainage imperative, in our opinion. Oozing, not readily controlled, even in a case otherwise acceptable for closure, also demands drainage.

As a general rule we drain when in doubt and, in the doubtful cases, use only a small cigarette or folded rubber dam, inserted to the base of the appendix. This is almost invariably done through the laparotomy wound, as we rarely, if ever, use a stab wound drain. Such drains are extracted in twenty-four or forty-eight hours, and primary healing is the usual result. Occasionally, however, through misjudging the case and the amount of drainage needed, a fairly severe infection ensues. This is also true at times in cases sewed up tight. The infecting power of the appendix has been made a subject of careful study during the past two years and will be reported in a subsequent paper.

In the more severe types of appendicitis, with widespread peritonitis, or

* Read before the Surgical Section of the New York Academy of Medicine, February 4, 1921.

large foul abscesses, especially the retrocæcal and pelvic types, we have employed, following the custom introduced by Doctor Gibson, the modified Mikulicz tampon. At times a few sutures are introduced in the parietes, but in general none are used. A firm pack of plain gauze inside the rubber dam is sufficient to wall back the intestine and a careful adhesive strapping prevents the expulsion of the whole mass with the bowel.

A review of all the cases of acute appendicitis occurring in the ward service of the Cornell Division during the years August 1, 1914, to August, 1920, has been made, numbering 818. Of these a large proportion, presumably 50 per cent., were closed without drainage. A smaller number were closed partially, using cigarette or folded rubber dam or rubber tube drain, and 162, or 19.8 per cent., were dressed with the Mikulicz tampon.

The mortality in the entire series was 34, or 4.15 per cent. In the Mikulicz cases it was 20, or 12.3 per cent.

It would of course be unfair to compare the Mikulicz series with the other acute cases as only the very severe types received the former treatment. A comparison of a Mikulicz series with another similar group of extreme cases treated by the usual forms of drainage, by the same operators, would be of some value, but unfortunately is unavailable. Comparison with other operators is of little worth because of variations in individual skill and judgment, especially in the classification of cases.

The post-operative course of the Mikulicz cases is of considerable interest. In the great majority there is an almost immediate cessation of the acute abdominal and systemic symptoms and convalescence is remarkably smooth. Dressings are practically painless. The parietes never undergo phlegmonous infiltration. Sloughing of the aponeurosis is rare. The wounds clean up superficially very quickly and cease discharging about the fourteenth day. Healing to a superficial granulating area occurs from the twenty-first to the thirty-fifth day, when the patients are allowed to leave the hospital. Complete healing occurs, as in all intraabdominal cases, at varying periods, depending on intraperitoneal conditions largely. Stitch sinuses are of course not seen.

It is well known that drainage of the general peritoneal cavity cannot be maintained more than forty-eight hours, but one has only to see the enormous amounts of secretion on the Mikulicz dressings for the first seventy-two hours to realize that something, presumably an injurious agent, is being eliminated. Taken in conjunction with the clinical manifestations, we feel that beyond reasonable doubt, our patients are relieved of their toxæmia by this thorough elimination. We feel that this factor occasionally turns the scale in critical cases.

Pocketing or residual abscess is rare under this treatment. When it does occur, relief is usually easy without an anæsthetic. A gloved finger in the wound quickly finds the encysted collection and induces free drainage.

By the fourth day the pack is usually entirely removed, the rubber dam or a fresh one, inserted, and measures conducive to cleansing the wound are

THE GIBSON-MIKULICZ TAMPON IN APPENDICITIS

instituted. The Carrel-Dakin treatment has given good results at this stage.

Evisceration has occurred very rarely and almost, if not entirely, in moribund cases. These seem to have little or no power to form adhesions and evisceration occurs as it does even in sutured wounds.

No attempts have been made at secondary suture in these cases. They have been strapped when clean, allowed to heal, and kept under observation for a year. At first the scars are linear and not easily told from sutured wounds, but gradually they hypertrophy and broaden out. A certain number develop hernia, usually a small affair and easily remedied. A few have been more extensive but in none has the repair been difficult, since no aponeurosis is lost.

An interesting feature of the repair has been the study of intraperitoneal conditions. We have been greatly impressed with the absence of adhesions of any moment and attribute this to the prompt alleviation of the local peritoneal suppuration.

CONCLUSIONS

We have no comparative statistics to offer that would be of any value, but we are quite sure from careful observation over a period of years and a considerable series of cases, that the Gibson tampon does lessen mortality in the very severe type of cases. We feel also that it lessens morbidity and suffering and that the number of post-operative hernias is no greater than in other forms of treatment, that the hospital stay is no longer, that the conditions of the wound and the intraperitoneal conditions are better than by any other form of drainage. If these things are true, the tampon, as improved by Doctor Gibson, is a real step in advance in the treatment of the more severe types of appendicitis.

I am greatly indebted to Doctor Gibson for the privilege of reporting these cases, all of which were operated upon in his service by the various members of the staff. I would also gratefully acknowledge the help received from Dr. John Lyttle for his help in compiling these statistics.

ACUTE APPENDICITIS—GIBSON-MIKULICZ TAMPON—ONE HUNDRED AND SIXTY-TWO CASES

Deaths, 20—12.3 per cent.

Excluding deaths, 142 cases; average stay in hospital, 22.4 days.

Shortest stay in hospital, 8 days.

Longest stay in hospital, 63 days.

Incision:

Intermusc., 74, or 52.1 per cent., average stay in hospital, 19.3 days.

Split rectus, 42, or 29.8 per cent., average stay in hospital, 25.5 days.

Rectus retracted, 26, or 18.1 per cent., average stay in hospital, 23.5 days.

Three reoperations for miscellaneous conditions, abscess, sinus and T.B. peritonitis.

Evisceration, 1; died on third day.

Repair—all successful.

MIKULICZ CASES

Total cases, 162.

Deaths, 20, or 12.3 per cent.

No follow-up record, 22, which leaves 120 cases to be considered.

Hernias occurred in 21 cases, or 17.5 per cent.

Reoperation in 12 cases, or 57.1 per cent.

Incisions:

Intermusc., 62, or 51.6 per cent., gave 13 hernias—20.9 per cent.

Split rectus, 34, or 28.3 per cent., gave 7 hernias—20.5 per cent.

Rectus retracted, 24, or 20.1 per cent., gave 1 hernia—4.1 per cent.

Incisions in 21 hernia cases:

Intermusc., 13, or 61.9 per cent.

Split rectus, 7, or 33.2 per cent.

Rectus retracted, 1, or 4.9 per cent.

CONGENITAL VALVES OF THE POSTERIOR URETHRA

BY ALEXANDER RANDALL, M.D.
OF PHILADELPHIA, PA.

OBSTRUCTION to urination from congenital valve formation in the posterior urethra though mentioned by Langenbeck in 1802, and subsequently by Velpeau (1832), Jarjavay (1865), and Tolmatschew (1870), is of sufficient rarity that Young, Frontz, and Baldwin (1919), collected but twenty-four case reports from the literature, though enriching it themselves by twelve further cases.

In that but *three* of these thirty-six cases were diagnosed by clinical means before operation, I felt the following report of two cases worthy of presentation.

The theories presented to account for such valve formations are of interest. (Quoting from Young, Frontz and Baldwin.) Up to the time of Bazy's article in 1903, they were assumed to be simple overgrowths of the small anatomical ridges that normally extend from the verumontanum upward to the vesical neck and from the same downward to the urethra walls. Bazy contended that the urogenital membrane of the embryo would occupy in the later stages of development, a position corresponding to the most frequent site of the valves in question, and believed these valves a persistence of this membrane. Thompson (1907) accepted this view and amplified it by likening the valves to an imperforate hymen, or persistent anal membrane. Lowsley (1914) considered them an anomaly of the Wolffian and Mullerian ducts. Young (1919), analyzing the thirty-six cases he reports, finds three different types of valve formation and assigns to the different theories their respective types, while at the same time calling attention to the work of Watson on the embryology of the verumontanum, who illustrates in a fourteen-weeks-old foetus abnormal bands attaching the top of the verumontanum to the roof of the urethra as another possible origin.

The vast majority of these cases are brought under observation during infancy or early childhood: thus twelve are reported under one year; nine from one to five years; four from five to ten years; making a total of twenty-five under ten years, as against nine above that age. The youngest is reported by Fuchs in a five-months foetus, while the oldest, a man of eighty-five years, was reported by Iverson.

CASE I.—J. C., aged five years, entered University of Pennsylvania Hospital May 23, 1917, in the service of Dr. Crozier Griffith, with the complaint of dysuria. It had been noted by his mother six months before that when he urinated he would cry. At one time

* Read before the Philadelphia Academy of Surgery, December 6, 1920.

it was observed that he passed a small blood-clot. He continued to suffer pain at each urination, and his mother observed that it would cut off two or three times during the act. His condition became progressively worse, and for the two days before admission he had been drowsy and refused to talk. Passed urine with difficulty the day before admission, and catheterization was imperative when the child was first seen in the receiving ward. Has had no diseases of childhood, though for two months before urinary difficulty was noticed, an excessive mucus discharge was observed at the meatus. The family physician states that at the onset of the trouble (October, 1916) the urine showed albumin, pus and blood-cells, but no casts. Temperature on admission was 100.2°.

Physical Examination.—Child lies quietly except for occasional choreiform movements of different parts of body, trunk, arms, legs or head. Is apparently stuporous, and dozes off when undisturbed. Examination of head, eyes, mouth and chest, negative. Abdomen very slightly distended, not tender except between symphysis and umbilicus. No muscular rigidity, no masses, no tenderness in costo-vertebral angles; genitalia and extremities normal.

Voided two ounces at 5 P.M. on day of admission, and three hours later bladder was found to extend half way to umbilicus, and the catheter recovered 8 ounces of urine with white, ropy sediment. Catheterization was not easy, though the difficulty was attributed to "muscle spasm." Child refused all nourishment and feeding was performed through nasal tube.

During the next three days the bladder was drained by inlying catheter and lavaged daily; improvement in urinary output and mental torpidity was marked. X-ray of urinary tract on May 27th was negative. On May 31st patient was urinating painlessly, and the elevated temperature had reached normal. The following day complete retention again occurred, the temperature rose to 103°, and the catheter was replaced with immediate relief of all symptoms. This sequence of events was repeated on two further occasions during the subsequent three weeks, and on June 21st cystoscopy was performed with the following report: "Bladder cavity very large; mucous membrane shows mild cystitis; both ureteral orifices are large and relaxed and a heavy cloud of pus seen to come from the right orifice. In the region of the verumontanum is a large, round, pale-white body, which almost occludes the posterior urethra and rises from the floor of the canal."

At the time this was considered a cyst of the prostatic utricle. On June 26th the patient was etherized. The supposed cyst was punctured with the fulgurating wire, and when it was seen not to collapse, the electric current was turned on and the entire mass of obstructing tissue severely desiccated.

Following this, the patient urinated voluntarily and without pain, and improved rapidly. On July 7th a third cystoscopy showed the obstruction to be absent, and only a small slough still adherent at

the site of fulguration. Both ureters were catheterized and their respective renal pelves lavaged with $\frac{1}{2}$ per cent. silver nitrate solution; pussy urine was obtained from the right which on culture showed *B. pyocyaneus*. On July 22nd the child was found to have five ounces of residual urine and a practically zero phthalein test, a slight discoloration only being obtained at the end of forty-five minutes' observation. Clinically he was greatly improved and sent home on August 5, 1917, under the care of his mother, a most intelligent woman. Report from the family physician on December 1, 1920, three and a half years later, states that the child has continued perfectly well, has developed normally, and has had no urinary difficulty at all.

Comment.—The condition in this patient was not appreciated until study of the literature brought forth the real embryological and pathological significance. It was evidently the third type of obstruction described by Young where an annular diaphragm obstructs the urethra, which diaphragm may be wholly or incompletely developed. On cystoscopy it appeared under the pressure of the irrigation as a tense wall suggestive of a cyst, but its failure to collapse when punctured immediately proved its character.

CASE II.—A. M., aged sixteen years. Admitted to University of Pennsylvania Hospital September 25, 1920; Cuban by birth; referred by Doctor Wilbur, of Hightstown, N. J., with a complaint of urinary frequency and enuresis. The patient had scarlatina at nine years of age, and no other disease nor any operations. During the past two years he has developed a frequency of urination which at first was every two hours and lately every hour. Even at his best urination becomes imperative at three hours and associated with pain just above symphysis. For the past ten months nocturnal enuresis has been constantly present. Once, about three months before observation, he had passed slightly bloody urine over a period of two weeks. His family and other personal history is negative, and he does not remember any urinary difficulty or weakness during childhood. Father, mother and one brother living and well. No brothers or sisters dead.

Cystoscopy (September 28th).—Instrument passes with ease and finds a small (10 c.c.) residual urine. The bladder wall is of normal pallor with slight trigonitis. The right ureter appears normally placed, but seen to gape open excessively on functioning. As the supposed left ureteral orifice was being located, the patient had a vesical spasm and the cystoscope was pushed into the posterior urethra. Further vesical cystoscopy was of little avail. The posterior vesical lip is a thickened bar with tense striations extending from it to the verumontanum, the latter being drawn up in close proximity to the vesical orifice. Instillation of $\frac{1}{2}$ ounce of 1 per cent. mercurochrome.

September 30th.—Catheterized specimen of bladder urine gave sterile culture.

October 4th.—Phenolsulphonephthalein test: 25 per cent. for first hour; 5 per cent. for second hour; total, 30 per cent.

Cystoscopy (October 6th).—Intravenous administration of 1.5 c.c. of 0.4 per cent. indigocarmine. Dye seen to be secreted in very faint traces in irrigation water in fifteen minutes and not observed from either ureteral orifice as repeatedly vesical spasm expelled the instrument into posterior urethra. The prostatic urethra is markedly dilated. The vesical neck raised and bladder orifice relaxed. Deep pittings penetrate down into either lateral wall of the prostatic urethra and at the extremity of the verumontanum is seen a fine frenulum which extends distally for about 1 cm. and, in dividing, forms what is apparently a definite valve on either side of the urethra, rising from the floor to each side wall.

Condition considered congenital valves of the posterior urethra, with pressure dilatation of the same and low kidney function from back pressure. For the next few days the patient showed an elevated temperature, and slightly elevated leucocyte count. There was slight cough and tenderness over Poupart's ligament. A second urine examination was negative for tubercle bacilli, as likewise a sputum examination. Wassermann and stool examination also negative. Blood studies practically normal.

October 20th.—Catheter placed in the bladder and 75 c.c. of 25 per cent. sodium bromide solution allowed to flow in under fluoroscopic examination. The opaque material was seen to immediately ascend to the right kidney pelvis and at the moment of vesical spasm a plate was exposed, which shows a small, markedly contracted bladder, distended posterior urethra limited at the valves' site, a dilated right ureter and right renal pelvis.

Close study of X-ray plates fails to show any evidence of a shadow from a left kidney. Two subsequent efforts to catheterize a left ureter were failures, principally on account of the vesical spasm on slight dilatation, making instrumentation very difficult.

Cystoscopy (October 29, 1920).—Both valves severely fulgurated and destroyed.

October 30, 1920.—Patient remarks voluntarily that urination is easier than he ever remembers.

Comment.—This is the first case that has ever been observed where the ureteral and pelvic dilatation has been unilateral. It is commonly recognized that one abnormality of the urinary tract is oftentimes accompanied by other congenital defects; though I tried every means within reason to establish the presence of a left kidney, the same remains clouded in doubt and for the present contraindicates surgical intervention other than the above effort to destroy the obstruction in the posterior urethra.

KRUKENBERG TUMOR OF THE OVARY*

BY PHILIP J. REEL, M.D.

OF COLUMBUS, O.

INTERESTING problems of investigation are always encountered when an attempt is made to account for the exact origin of solid tumors of the ovary. No organ in the human body presents more difficulty in the histogenesis of its tumors. These growths comprise fibromas, sarcomas and carcinomas, and while not exceptionally rare, neither are they the types most frequently encountered. This group of neoplasms taken collectively possibly occur more frequently than the literature would seem to indicate. Fibromas and sarcomas are usually given as comprising 2 per cent. and 5 per cent. of all ovarian tumors, while carcinomas are of much more rare occurrence.

In 1896 Friedrich Krukenberg described a bilateral ovarian tumor to which he gave the name "fibrosarcoma ovarii mucocellulare (carcinomatodes)." Although he considered these tumors of a fibrosarcomatous nature, his attention was directed to various areas wherein large epithelial cells appeared, some of which were arranged in definite tubules. These cells were described as being distended with mucoid material, which, after pushing the nucleus to one side, caused them to present a signet-ring appearance.

In 1917 our attention was drawn to the Krukenberg tumor of the ovary while making a study of ovarian neoplasms. At this time a bilateral growth of the ovary was encountered in a woman of thirty-three years. Operation disclosed a retroperitoneal involvement of the lymphatics but failed to reveal any definite evidence of a primary growth in the gastrointestinal tract. In 1916 Stone called attention to the importance of cancer metastasis, emphasizing the possible channels by which secondary growths make their appearance in the ovary. He concluded that metastasis occurs either by direct extension through the retroperitoneal lymph-nodes, by permeation or retrograde transportation, or by peritoneal implantation. Major in 1918 presented an excellent paper including a review of the literature and cases reported to date and was of the opinion that surface infection may play an important rôle in explaining the route of certain metastases. In the case studied by him, however, the blood-stream was suggested as a possible route, by finding the tumor cells in the pulmonary circulation at the time of autopsy.

Krukenberg in his original study considered the tumor as being primary in the ovary. Since then it has ever been the occasion of considerable discussion. A review of the literature reveals one group of observers

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who describe the tumor as being primary, while the other group consider it as a secondary growth. It would seem that a misinterpretation resulting from insufficient data could account for quite a number of the cases considered primary in the ovary. It is generally recognized that a malignancy occurring as a bilateral involvement in paired organs, such as the kidneys and ovaries, in most instances indicates a primary growth situated elsewhere in the body, which may present no clinical symptoms, and may be impossible of clinical diagnosis.

In order to avoid repetition, a brief résumé of Major's conclusions with reference to the cases collected up to 1918 would reveal that fifty-five cases have been reported in the literature, and to these eight probable cases may be added. "Eighteen cases were collected in which the



FIG. 1—Gross photo of ovaries The darkened area of the larger is that of recent hemorrhage

presence of a primary growth in the gastrointestinal tract was demonstrated." To these we may now add a case reported by Chapman in July, 1920, and the one serving as a basis for this discussion, making a total of twenty.

The following case is presented as a contribution to the study of this most interesting subject. The striking feature of this case is the lack of symptoms presented until just a few days prior to operation in spite of the presence of a marked pelvic and abdominal involvement.

The patient, H. H., a white girl, single, aged twenty-one years, was admitted to the University Clinic complaining of acute abdominal pain associated with what she stated was a rather sudden enlargement of the abdomen. Her family and past history were negative. She began menstruating at eleven years and had always been regular, flowing from four to five days, with no pain or discomfort until the period in which this attack commenced. The patient while bending over to lift a pail of milk was taken with a sudden, sharp pain in the lower abdomen. This pain was so excruciating

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that momentarily it was impossible for her to arise. During the next few hours the menstrual flow increased very greatly in amount. She was insistent that it was at this time that she first noticed the abdominal enlargement. A little later, however, a more careful questioning revealed the fact that she had worried some over a possible pregnancy during the past three or four months, because of a progressive enlargement of the lower abdomen, even though she had not experienced any of the more common symptoms. There had been no gastrointestinal disturbances or loss of weight prior to this attack. Her family physician was called and diagnosed the condition as an "acute surgical abdomen," and sent her into the Clinic on the following day, July 6, 1920.

When seen in the hospital under the service of Doctor Wardlaw and myself she complained of abdominal pain, low down, and presented some tenderness over the left and larger of the two palpable masses. Her temperature was 102.5° . This fell to normal after a few hours rest in bed and remained so.

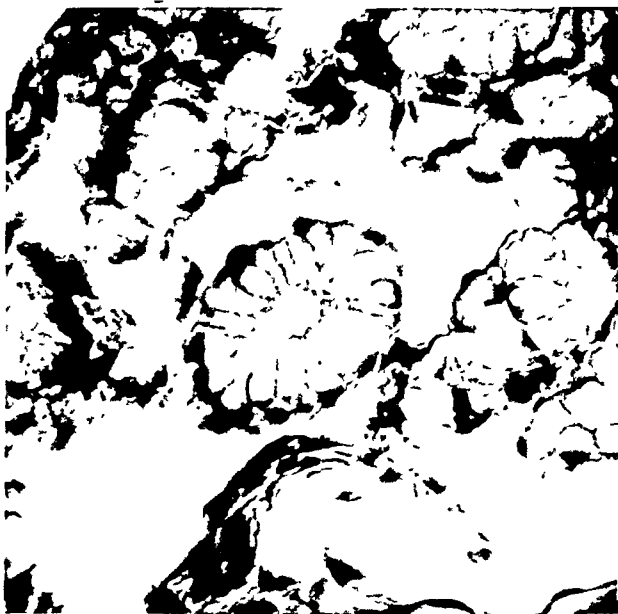


FIG. 3.—Photomicro, higher power, showing cross-section of tubule. This has every appearance of being gastrointestinal in origin.

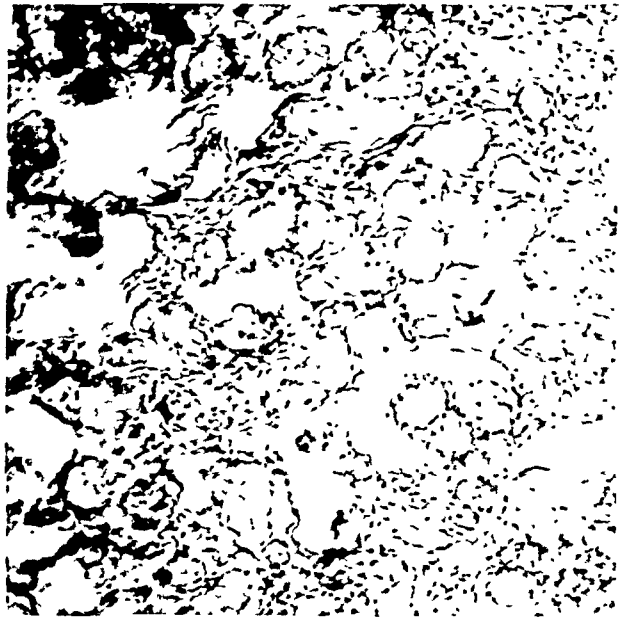


FIG. 2.—Photomicro, low power, showing stroma arranged loosely and enmeshing the tubule-like arrangement of the epithelial cells.

Physical examination of the head, neck, and chest revealed nothing of note. The lower abdomen was irregularly distended. Palpation disclosed two distinct tumor masses apparently arising in the pelvis. These enlargements while cystic in shape were non-fluctuant and presented strong evidence of being solid. The growth on the left side extended well out of the brim of the pelvis and ended bluntly but distinctly about two fingers' breadth below the umbilicus. There was some

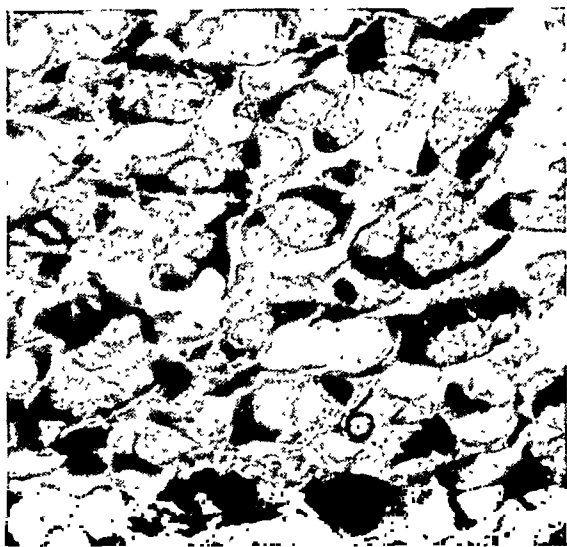


FIG. 4.—Photomicro, high power, showing a more cellular area composed of large ovoid-shaped cells distended with mucoid material which has pushed the nucleus in many instances to one side, forming a signet-ring appearance.

tenderness over the anterior portion of this mass. The growth on the right could be palpated just above the pubes. Both were slightly movable from side to side. Pelvic examination revealed a small, hard, conical cervix and a palpable fundus immediately behind the symphysis. Under ether relaxation both tumors were easily diagnosed as being ovarian. The urine, blood, and Wassermann were negative.

On July 7, 1920, under ether anæsthesia, the abdomen was opened and revealed an enormous enlargement of the left ovary with a similar but smaller involvement of the right. About 500 c.c. of clear serous fluid was found free in the cavity. The size of the left ovary necessitated an incision well above the umbilicus, rendering possible very thorough examination of the entire abdomen. The stomach was found to be markedly involved and undoubtedly presented the primary growth. From this the omentum, mesenteries, anterior surface of the spleen and a large portion of the small and large intestine were invaded by metastatic extension. The liver and gall-bladder were entirely free. The parietal peritoneum of the pelvis was studded with nodules. These increased in size and number as the more dependent portions of the pelvis were reached. The uterus was smooth and no larger than one which has been pregnant and had undergone normal involution. The extensive involvement of the broad ligaments and surrounding structures prevented its removal. A double salpingo-oöphorectomy was performed.

The immediate post-operative convalescence was uneventful, and the patient left the hospital on

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FIG. 5.—Photomicro, low power, showing area of hemorrhage. The blood-vessel is engorged with blood, surrounding which is a marked perivascular hemorrhage.

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August 15, 1920. Shortly after, however, she began to lose weight and died September 10, 1920. Unfortunately it was impossible to obtain an autopsy.

Grossly, both ovaries and tubes retained their normal shape and contour. The left weighed 1110 gms. Its general smoothness was interrupted by what seemed to be merely enlargements of the indentations and cleft-like scars seen on the surface of the normal ovary. The general consistency was firm throughout, with an occasional small area of superficial softening. The anterior, and a portion of the external lateral surface, presented a rather large area of hemorrhage of recent date. This no doubt explains the attack of sudden pain. The accompanying tube was moderately enlarged and congested, but presented nothing further. Upon section, the cut surface was whitish in appearance, excepting for the area of hemorrhage, and the entire tumor was solid, presenting several areas of myxomatous degeneration, and one small cyst measuring 2 cm. in diameter. The right ovary and tube, although smaller, weighing 360 gms., presented the same general structure minus the hemorrhage and cyst formation.

Microscopic examination revealed no normal ovarian tissue in the many sections studied. The stroma, in its arrangement, corresponds in every way with that accepted as the Krukenberg tumor. Distributed throughout the connective tissue are cells which, in their morphology and arrangement, have the distinctive appearance of epithelium. Although infiltrated with these cells, connective tissue predominates in certain areas, while in others it is loose, and enmeshes the tubule-like formations. Again, in other portions, the cellularity is marked and these large clear cells distended with mucoid material constitute the entire picture. In the less compact areas the stroma takes on a myxomatous appearance. Many of these tumor cells, ovoid in shape, are greatly enlarged and filled with a clear mucoid material which in many instances has pushed the nucleus to one side, causing a signet-ring appearance. Throughout the tumor, these cells show a decided tendency to arrange themselves in tubules.

When an attempt is made to interpret the findings at the time of operation, it would seem highly improbable to consider the ovarian tumor to be anything but secondary to a primary growth elsewhere in the abdomen. This was undoubtedly in the stomach from which the metastatic growth had taken place. This impressed one as being in the nature of rays of light extending downward along the contiguous surfaces of the underlying viscera, and ending in a focus in the pelvis. Although not proved by autopsy, it would seem that peritoneal implantation or surface infection as described by Major played an important part in the route of extension. The freedom of the liver from metastasis would hardly have been likely in the presence of such marked involvement elsewhere, had the lymphatic system been the channel of secondary invasion.

SUMMARY

The histogenesis of solid tumors of the ovary is always interesting and should warrant a careful investigation of each case encountered. This tumor is similar to that described by Krukenberg, but presents very strong evidence of being metastatic in origin. This bears out the more recent investigations which tend to prove that, in the vast majority of instances, solid tumors of the ovary are secondary to a primary tumor situated elsewhere in the body.

It is possible for these growths to attain enormous proportions in the absence of clinical manifestations. A review of the literature reveals that they occur most frequently before the age of forty, and that they are more malignant in character than is sometimes stated.

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THE TREATMENT OF UNUNITED FRACTURES*

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SECTION ON ORTHOPÆDIC SURGERY, MAYO CLINIC

UNUNITED fractures may be classified in two groups, fractures delayed in uniting and fractures that may properly be regarded as without union. The chief difference between the two types is that often the former may be coaxed, as it were, into solidity by some means other than operative procedures, whereas the latter is a fixed condition that will not change and union can be obtained only by operative means.

Any measure that will bring about union in such cases may be employed, but most surgeons doing a great deal of bone work find that bone grafting is the preferred method. The intramedullary graft advocated by Murphy has been employed successfully in certain cases, and may still be included in the different procedures of obtaining union, but it has been my experience that it does not compare favorably with other methods. The objection to the intramedullary graft is that it is a piece of cortical bone placed within the medullary cavity, in reality a foreign body, which is gradually absorbed. It only aids in obtaining union because it acts as a splint primarily, as a mild irritant secondarily, which leads to increased blood supply to the fractured ends, and because it has within itself the natural bone salts necessary to insure the deposition of callus.

The sliding inlay graft advised by Buchanan and Albee appears to be well-nigh perfect mechanically. The inlay as a sliding reversible graft in the tibia is probably the method of choice in the repair of this bone if a high degree of osteoporosity is not present. Because osteoporosis is often present it has failed in the hands of skilful operators, and it is now usual to take the bone from the opposite tibia and practically never to use a sliding graft in other bones.

It is difficult to determine just why the inlay graft should fail in cases in which we have known our technic was all that could be asked. Recent investigations in bone transplantation and bone regeneration have brought out the fact that cancellous bone of the endosteal tissue is rich in osteoblasts. These cells make new bone; the adult bone-cells probably have little or no bone-forming properties. The osteoblasts are to be found in small numbers beneath the cambium layer of the periosteum, in slightly greater numbers in the Haversian canals, and in the greatest numbers in the cancellous bone. It is therefore essential that

* Read before the State Meeting of the American College of Surgeons, Denver, Colorado, December, 1920.

as much as possible of the cancellous tissue of the fragments and of the cancellous tissue of the grafts should be saved and placed in contact.

When the slot is made for the inlay graft, the cancellous bone and all layers of bone are removed the entire length of the slot, and after the

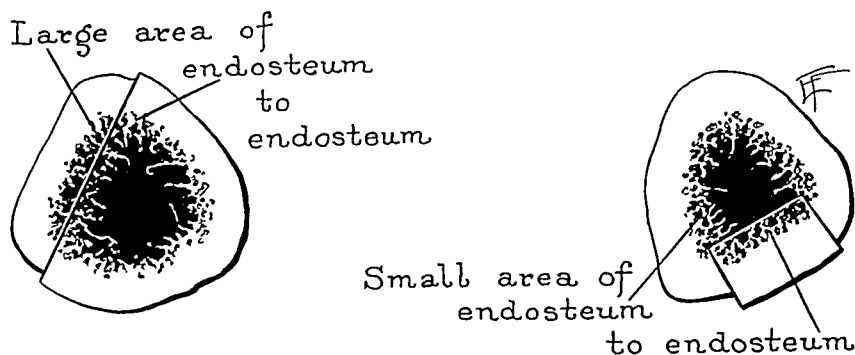


FIG. 1.—Areas of endosteum to endosteum.

bone graft is fitted into the slot, the only point of contact between the cancellous tissue of the graft and the cancellous tissue of the fragments is at the edges of the graft (Fig. 1); thus comparatively little cancellous tissue meets cancellous tissue, and since this is the tissue that fur-

nishes the largest number of osteoblasts or bone-forming cells, it is not to be wondered at that the graft's vitality is often lost and that the graft is slowly absorbed.

I believe it is more than probable that a bone graft may retain its vitality if enough contact of cancellous tissue of the graft to the cancellous tissue of the fragments is secured. Therefore, it is now my custom to use the bone graft in the form of a massive graft in which the periosteum and hard cortical bone of the fragments are chiseled off, exposing a large area of cancellous tissue. Against this is placed the cancellous or endosteal side of the graft which contains all the layers of bone; this is clamped or held in place by the aid of beef-bone screws (Fig. 1).

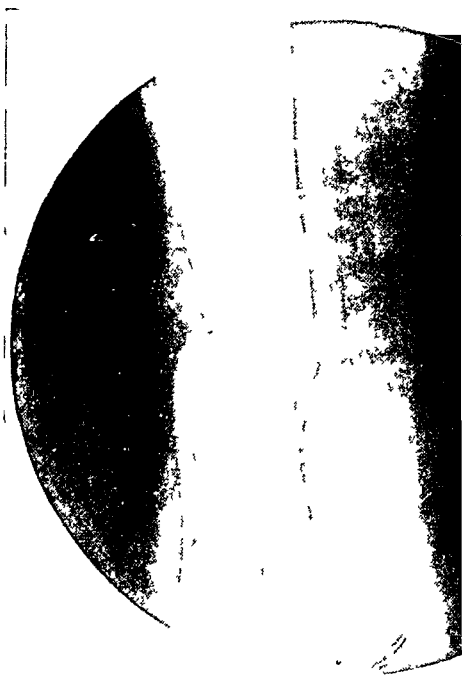


FIG. 2.—Non-union of the tibia and fibula in the lower third.

teum and hard cortical bone of the fragments are chiseled off, exposing a large area of cancellous tissue. Against this is placed the cancellous or endosteal side of the graft which contains all the layers of bone; this is clamped or held in place by the aid of beef-bone screws (Fig. 1).

THE TREATMENT OF UNUNITED FRACTURES

In a recent study of the end-results following forty-two operations for non-union of the humerus on thirty-four patients, it was found that the use of the massive graft gave a higher percentage of good results than any other method. Next in importance to the proper method of using the bone graft is the problem of post-operative fixation. The fixation must be varied according to the case and the conditions surrounding the patient and the surgeon, but plaster-of-Paris is probably the most convenient method of securing the necessary fixation. For fractures of the

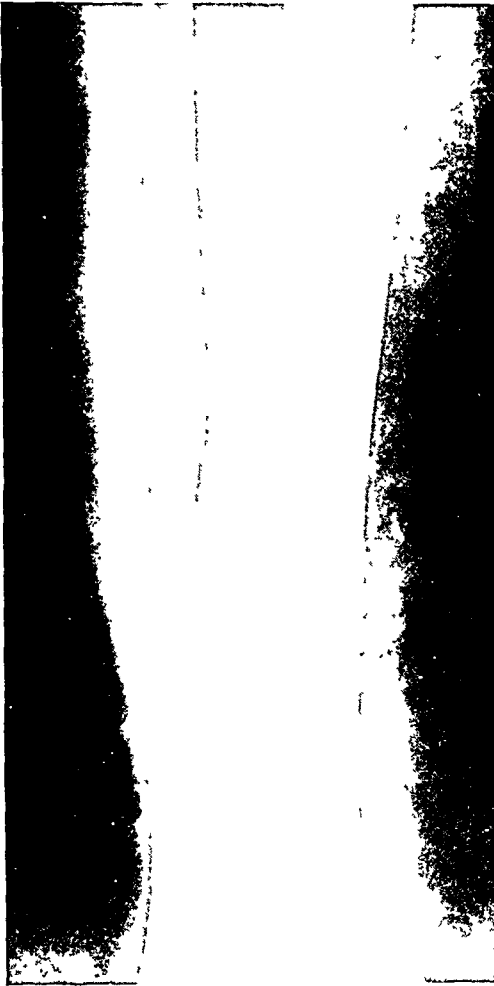


FIG. 3.—Union by the inlay graft obtained from the opposite tibia. Beef-bone screws were used to hold the graft in place.



FIG. 4.—Non-union of the tibia and the fibula of seven years' duration.

humerus a ledge or trough for the arm to hold the elbow flexed and across the front of the body is incorporated in a body cast. Immediately after the operation the arm is placed in this trough, covered by plaster-of-Paris bandages, and securely bound to the side for from four to eight weeks. If the patient's temperature is normal and there are no signs of infection it is not essential to examine the wound for eight or ten weeks even though non-absorbable dermal sutures are used. In the fixation of fractures of the tibia, naturally the ankle and the knee must be included in the cast. In the fractures of the thigh the cast may include

the pelvis and extend to the toes. In certain high fractures of the femur, or in fractures of the hip, it has been our custom to apply a plaster-of-Paris double spica cast extending from the ribs to the toes on the affected side and to the knee on the opposite side, with the legs in abduction, the cast being reinforced by a splint placed transversely from knee to knee. In the forearm the cast should run to the heads of the metacarpal bones and up to the middle of the arm at least.

Many of these ununited fractures have been operated on before we see them. Many have been compound fractures with infection. Unfor-

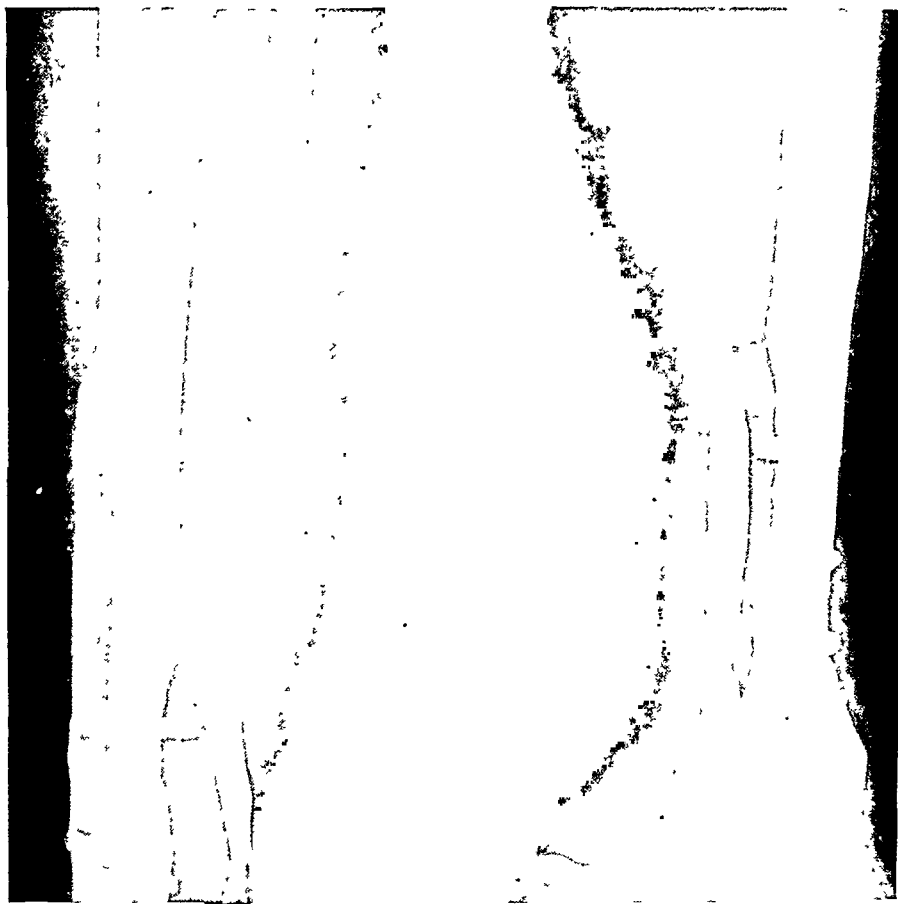


FIG. 5.—Union obtained by taking the fibula from the same leg and using as a massive graft. Beef-bone screws were used to hold the graft in place.

tunately, even after the extensive experience furnished by the war, there is no hard and fast rule as to the exact time operation is safe in cases previously suspected. We have seen cases in which the infection was stirred up eighteen months after the sinuses had closed, and cases in which there was a pocket of pus in the tissues a year after all sinuses had closed. As a rule, much may be learned from whether the wound is red, tender, œdematous, and so forth, conditions which, in the main, are contraindications to interference. Successful interference has been reported in the face of such conditions, but such instances are the exception and not the rule. Certain types of

THE TREATMENT OF UNUNITED FRACTURES

ununited fractures are often treated better by the aid of some metal plate, notably, fractures of the femur with marked deformity and considerable tension of the muscles when the fracture is reduced and the parts stretched. It is plainly evident under such conditions that something in the way of a firm internal splint must be used, and we have not infrequently found it necessary to use two metal plates to maintain the position. It is advisable, however, to tell the patient that these splints are put in merely as a temporary means of holding the fragments in position and that they should be removed when union has taken place. In recent years we have used metal plates less often, although we believe they should be recognized definitely as a proper means of treatment. It may be accepted as a good general rule that metal or non-absorbable material should be used as little as possible in the treatment of ununited fractures. Even in the femur we have used, of late, more beef-bone plates than metal plates. The bone is almost as strong and in fact stands *more stress without bending than the metal*. Beef-bone may break but will not bend, whereas the metal plates will bend and allow malalignment.



FIG. 6.—Non-union of the neck of the femur of five months' duration.

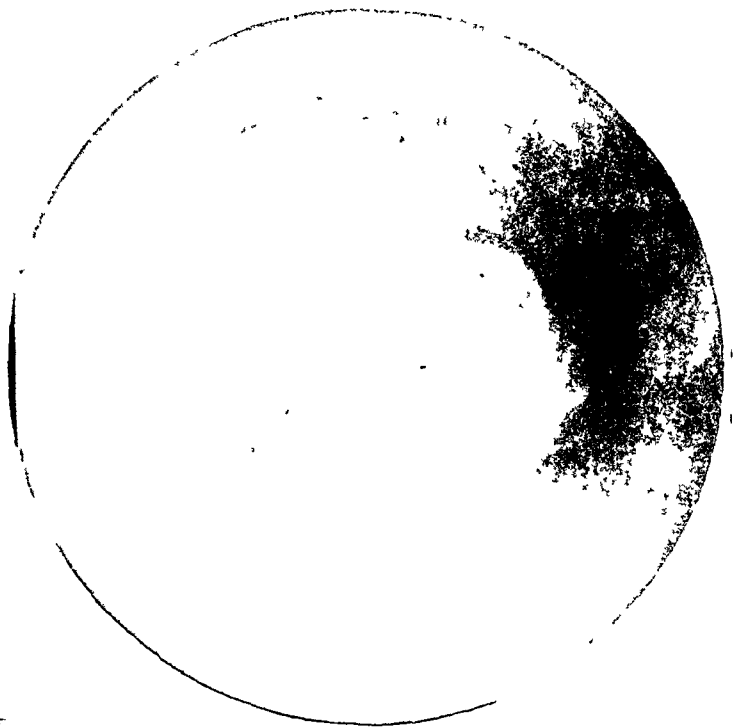


FIG. 7.—Fibula used as a peg. Union secured.

The metal plates are more applicable to recent fractures than to old ununited fractures.

As a rule, marked osteoporosity of fragments means failure. The osteoporosity may be due to prolonged fixation in apparatus or casts, and in such cases it is better to remove all fixation and encourage the use of the part. This may make the pseudoarthrosis more marked, but as

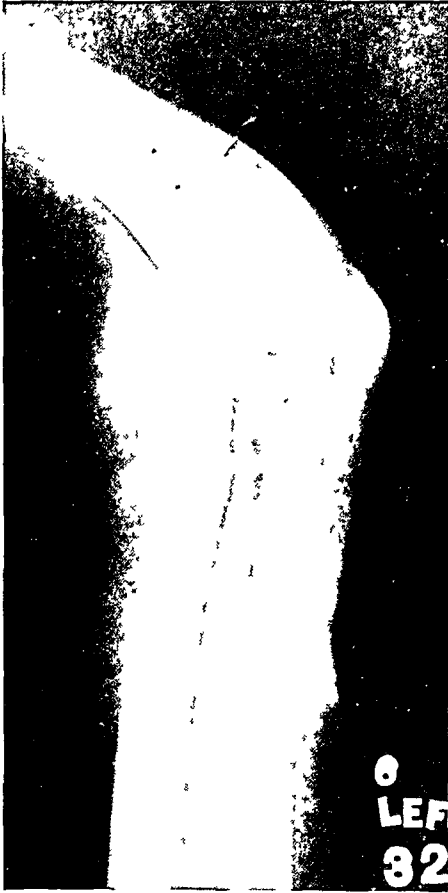


FIG 8 —Ununited fracture of the ulna

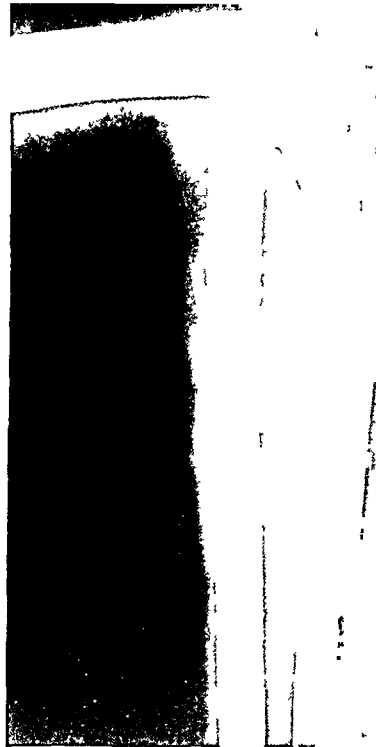


FIG 9 —Massive graft taken from the tibia and applied to fragments, and held in place with beef-bone screws.

the bone ends become eburnated the necessary bone salts are deposited for bone repair.

Beef-bone screws may be used to hold the fragments in apposition, if the fracture is oblique, or if the step operation is performed. Holes are bored with a drill and then threaded by the proper size tap and beef-bone screws placed through. These screws are non-irritating and absorbable.

FRACTURES OF THE TIBIA

CASE 278532.—Mr. L. M., aged twenty-four years, came for examination July 5, 1919, because of ununited fracture of the right tibia and fibula, caused by a bullet from a revolver (Fig. 2). The bones had been sutured the next day with silver wire. Suppuration followed and five

THE TREATMENT OF UNUNITED FRACTURES

months later the wires were extracted. The patient was operated on again within a year without union.

July 9, 1919, we placed a bone graft from the left tibia as an inlay, held in place by four beef-bone screws. Union followed (Fig. 3).

CASE 279058.—Miss M. J., aged twenty-one years, came for examination July 11, 1919, because of non-union of the lower third of the left tibia of seven years' duration (Fig. 4). She had been operated on five times, each time believing that union had occurred; twice metal plates and twice bone grafts were used, but each time the union broke down.

July 22, 1919, we operated, using a piece of the fibula as a massive graft. Good union was secured (Fig. 5).

FRACTURE OF THE FEMUR

CASE 307814.—Mrs. M. M., aged thirty-five years, came for examination March 2, 1920. She had fallen on ice and fractured her hip about five months before. She was in bed ten days. Röntgenograms did not show a fracture at the time and she was allowed to be up on her feet for two weeks; a cast was then applied and worn for two and one-half months (Fig. 6).

At operation, March 12, 1920, the fracture at the neck of the left femur was found to be ununited. A piece of the fibula was used as a transplant. At examination June 25, 1920, union was complete (Fig. 7).

FRACTURES OF ULNA AND RADIUS

CASE 321468.—Mr. S. W., aged twenty-one years, came for examination June 23, 1920. One year before his left forearm had been struck by an airplane propeller and the ulna fractured (Fig. 8). The fracture was set immediately and again two weeks later. Twenty-one days after the accident operation was performed and the bone plated. The bones did not unite and the plates were removed two months later and a cast applied for six weeks.

June 25, 1920, operation was performed at the clinic; a piece of bone from the flat internal surface of the left tibia was affixed as a massive graft to the fragments by the aid of four beef-bone screws. October 14, 1920, the bone graft was firmly united and the fracture solid.

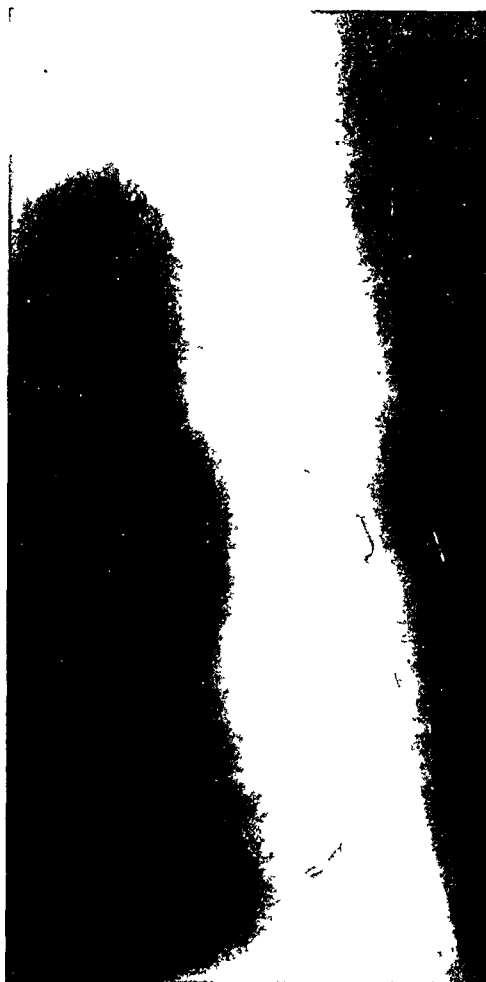


FIG. 10.—Non-union of the humerus.

FRACTURE OF THE HUMERUS

CASE 300181.—Mr. R. G. P., aged forty-five years, was examined at the clinic December 20, 1919. Nine months before the left arm was caught in the belt of an engine; the humerus was broken near the head and in the middle of the shaft (Fig. 10). The arm had been placed in a cast. Union was obtained in the upper fracture, but not in the lower.

We placed a massive graft from the tibia with three beef-bone screws in each fragment and union and full function were obtained in less than six months (Fig. 11).

RÉSUMÉ

As a result of our experience in the treatment of ununited fractures we believe that the bone graft is primarily the method of choice, but there



FIG. 11.—Massive graft, held in place with beef-bone screws

are certain conditions in which it is probably not the best method. Frequently in operations on certain ununited fractures of the femur with much fibrous tissue and abundant callus, in which bleeding is very free and cannot be controlled absolutely, we have found it better to use metal or beef-bone plates, which are more easily applied than autogenous bone grafts. Beef-bone plates and screws are not irritating and have sufficient strength to stand the strain. In treating ununited fractures of the tibia the inlay graft is probably the method of choice; this, like all bone grafts, should be held firmly in place by the aid of beef-bone screws. In the femur and humerus, and in the radius and ulna, we prefer the massive bone graft which permits the approximation of the cancellous tissue, which is rich in osteoblasts, of the graft and of the fragments.

AN INTEGRAL TRACTION-PROVIDING SPLINT FOR VICIOUS FRACTURES OF THE FEMUR *

BY HARVEY C. MASLAND, M.D.
OF PHILADELPHIA, PA.

SINCE the Great War as a school of experience, much has been written concerning the care of fractures of the long bones. In fractures of the lower limb the Thomas splint has emerged supreme as the best emergency agent. Civil practice, however, is different from the conditions upon a battlefield. In a few hours the patient is removed to a place satisfactory for the permanent treatment of the injury. Hence the question is practically immediate of setting the fracture and providing the best mechanical means of holding the bones in normal relation till Nature has reunited the broken parts. In the selection of our equipment very many questions arise. There must be the most perfect possible correction of the deformity. The parts must be retained in this normal relation during the days of healing. The comfort of the patient must be given consideration. This is most important in those of lowered vitality or of advanced age. Many a life has been sacrificed, in fractures of the femur especially, for while the fracture has been retained in good position, yet the tax of the treatment has caused complications that have sapped the vitality.

Traction is an element that must be considered in every fracture of the long bones. Here must be considered the point that the misplaced bones act as an irritant to the surrounding soft tissues and excite a contraction that holds the bones in continued malposition. Logically, then, where the bones have been set in normal position not so great traction is necessary in the after care. A point that arises here is that a fracture which cannot be replaced by the indicated manipulations under ether will not give a greater degree of reduction under subsequent traction. Where there is marked deformity manipulation applied under ether will bring many of these bones into apposition and if the irregularity of the fracture is sufficient to catch and prevent slipping, the parts will remain in position till they are retained by gentle placement in an appropriate splint. To digress for a moment; in acute fractures, the question of open operation should only be considered where skilful manipulation fails to bring the parts to a sufficient replacement. If the parts can be brought into position but there is a non-serrated oblique fracture, then a suitable traction splint should prove sufficient.

With the presentation of these thoughts, we can now turn to the consideration of those fractures where our ingenuity is sorely tried in maintaining a replacement. I wish to consider, possibly the most rebellious of all; the vicious fractures of the femur.

* Read before the Philadelphia Academy of Surgery, December 6, 1920.

The old dictum called for immobilization of the joint above and below the fracture. Numerous writers have maintained this was not a prime essential. The stiff joints that have followed the treatment of many fractures have been adduced as objection to the prolonged fixations of the joints. Undoubtedly there is a possibility of such a complication following, particularly in the aged, the rheumatic, or others of lowered vitality. The conviction is forced upon me, however, that many of these cases are caused by the irritation of the treatment and the incomplete replacement of the bones. It is nature attempting to minimize the injury to the tissues. In other words, the nearer we obtain a perfect replacement and a comfortable unirritating splinting, the less the likelihood of a permanent stiff joint. In my opinion, the fixation of the hip-joint and thus of the upper fragment for at least the first three weeks of the course of treatment of a fractured femur outweighs the danger of ankylosis.

All the various modifications of the Thomas and the Hodgen splints, the suspensions, the longitudinal and lateral tractions, the abductions of the limb, the Bucks and the ice-tong traction, have for their objects the giving of as much fixation as possible, as much traction as is needed and such position of the limb as would secure the greatest degree of muscle coördination and relaxation. All these are planned to secure and maintain the best possible replacement. It is recognized that none of these treatments will permit the patient to ease the position of his body without moving the limb and disturbing the adjustments. This causes some pain with its consequent stress to the system. The tractions, longitudinal, vertical or lateral, are to some point on the bed. Any change of the patient's position disturbs the direction and the intensity of the pull of these tractors.

The two usual counterbalances to the limb traction are in the pelvic ring of the splint and the weight of the body. The pelvic rings are fixed sizes calculated to rest against the ischium, a one-point support. This permits of but a limited amount of pressure without pain.

These deficiencies work to the discomfort of the patient, the lack of accuracy in the treatment and the irritation of the soft and hard tissues. We must ever recognize that the degree of traction and pressure is limited by the ability of the patient to bear the strain.

My studies of this problem have extended over many months. I am convinced that the splints in use do not utilize all the opportunities offered by the body to distribute the strain and so allow greater traction with less discomfort. They distressingly limit the freedom of movement of the patient. I present this splint (Figs. 1, 2, 3) as an effort to solve the difficulties encountered. It is an advance over the splint presented in the April, 1920, issue of "ANNALS OF SURGERY." The present splint is indicated where a greater degree of traction is necessary as in fractures below the trochanters, where both lateral and longitudinal traction may be required. It is provided in such shape that the surgeon can readily bend and assemble to fit the individual patient. The splint has a body portion and a limb portion which can

FIG. 1

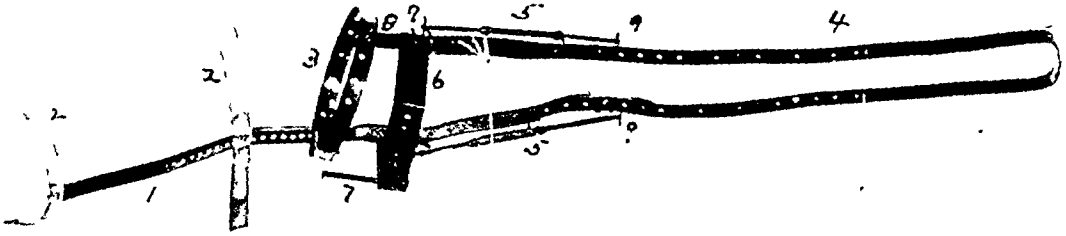


FIG. 2

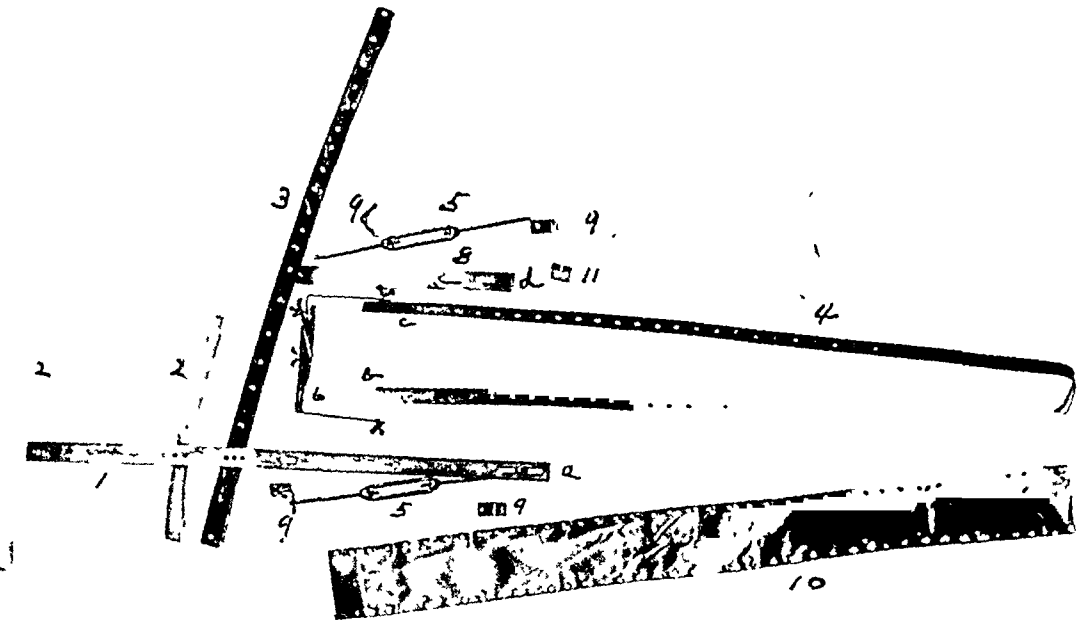


FIG. 3

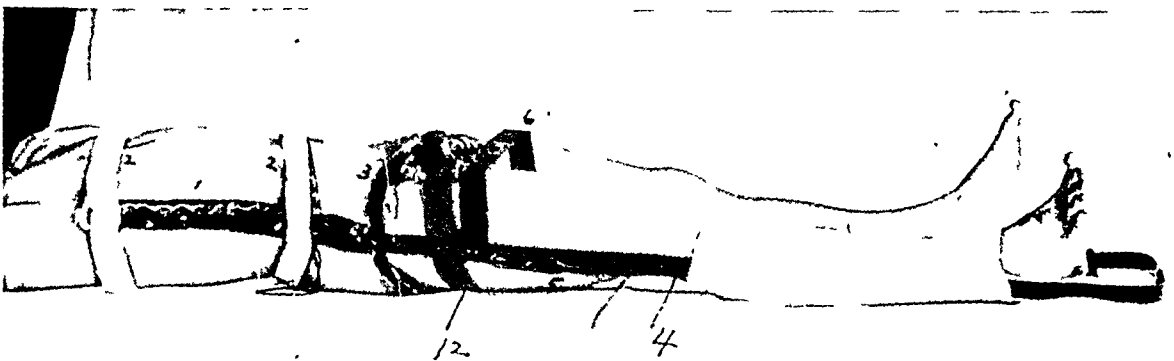


FIG. 1, 2 AND 3.—1, body splint; 2, axilla and waist bands; 3, buttock ring; 4, limb splint; 5, turn-buckles; 6, adjustable bridge; 7, bridge arm for lateral traction band; 8, upper inner thigh splint; 9, brackets for turn-buckles; 10, eyeletted artificial leather to lace over splint and padding; 11, guides to hold a-b and c-d during extension, 12, lateral traction band supported on arm 7.

SPLINT FOR VICIOUS FRACTURES OF THE FEMUR

be immediately connected with screws and wing nuts. Where extension is needed this is not done before the turnbuckles have been mounted on the overlapping arms and the required extension made. It will be seen that if movement of the joint is required during the course of the treatment the two elements can be freed quickly at this point and the splint as a whole is not removed.

The body arm extends from the axilla, follows the lateral contour of the trunk past the pelvic ring and well down toward the knee. The pelvic ring is adjusted to rest as near as possible on the ischium, the pubic bone and the ilium. The trunk arm makes the hip-joint immobile. Following the curves of the body, it cannot turn as does a straight splint. Two cross arms at the axilla and the waist line are bound to the body with adhesive plaster. No bandages are used here and the back is open to bathing and other needful care. Attached to the pubic side of the pelvic ring is a splint arm which follows the inner contour of the thigh well down to the knee. The pelvic ring adjusted to the particular pelvic bone and the trunk arm likewise adjusted to the side of the body permit a distribution of the counter pressure so that a greater degree of strain with the turnbuckles can be exercised with less discomfort to the patient.

The leg portion of the splint has an arm extending down from the upper third of the thigh following the external contour of the limb. It is bent across the sole with abundant clearance for a Buck extension. It then turns up and follows the inner contour of the limb to within 4 or 5 inches of the perineum.

To measure the contour of the parts, the patient lies flat and straight on the bed. If he is symmetrical the sound side can be measured. A tape line is stretched from the axilla to beyond the foot parallel to the axis of the body. About every two inches from the axilla down, a ruler at right angles to the tape line gives the distance to the contacting part of the body. Special points like the axilla, the waist line, the ilium, the pubic crotch should be noted. Using a seam on the floor as a straight line these distances are marked and a connecting line gives the curves of the parts. The splints are then bent to these lines. At the ilium and the pubis the arms are sharply bent to accommodate the pelvic ring more readily. A pair of bicycle wrenches serve to make the curves, particularly the sharp bends for the pelvic ring. The length, circumference and height of the thigh at the pubo-ischiac iliac line are taken and the ring bent accordingly, allowing about four inches for padding, etc.

It will be noticed that all the arms have numerous holes. These allow the arms to be bent to any adult and yet permit a ready assembling of the various parts with machine screws and wing nuts. In the leg splints are additional holes which are threaded. The leg arms are to be imbedded in *plaster of Paris to an extent to give a good brace for the extension with the turnbuckles*. The threaded holes are for machine screws to be screwed in tight with the screw ends projecting away from the limb. These give an

anchor in the plaster of Paris. Before the plaster of Paris is applied a Buck extension is put on the leg. The plaster of Paris and Buck extension appeal to me as utilizing all possible vantage ground on the lower limb to distribute the strain. Where the thigh portions of the body splint and the leg splint are in relation to each other the arms of the body portion are placed external to the leg arms. This permits the more convenient assembling of the turn-buckle brackets and the bridge for lateral traction. It is perceived that when the turn-buckle brackets are fastened to the respective arms and the turn-buckles attached, opening the turnbuckle will exercise any degree of separation longitudinally that we can safely use. Some of the holes in the overlapping thigh splints are slotted. This insures that there will always be opposing openings through which to pass a screw. After distraction is complete and the added rigidity of the splint afforded by the turn buckles is not needed, the screws are passed through the overlapping ends and the splints are tightened on each other with the wing nuts. Then the turn-buckle assemblies can be removed, leaving a neater appearance.

For the lateral traction that may be needed two freely holed angle plates are attached opposite each other on the side splints with the other arms lapping over each other commensurate with the width of the thigh. These overriding arms are bound together with a screw and wing nut. An arm is now attached to this bridge at a point that will give the lateral traction in the direction desired. A broad band is passed around the end of bone to be elevated. The ends are brought over derrick arm and clamped tight with the degree of lift desired.

The body portion of the splint with the pelvic ring are padded and covered with artificial leather, laced on, before applying to the body. The other exposed parts are padded and covered with artificial leather after adjustments are completed.

To summarize the features of this fracture dressing:

The joints above and below the fracture are immobile.

The individual fit of the splints insures their better retention in position.

The body and the fractured part are open for inspection and the needful attention.

The strain of traction is distributed in wider degree over salient parts of the body.

The traction can be applied in the direction and to the degree required.

The traction is wholly integral to the splint.

The patient can move or be moved on the bed without disturbing the direction of traction or the relation of the parts.

Comfort and well-being are conserved in the highest degree.

THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET *

BY J. TORRANCE RUGH, M.D.
OF PHILADELPHIA, PA.

EXPERIENCE in the pre-combat work of the World War has justified to the writer the conclusion that the great confusion which existed among the medical officers (and still exists to a great extent among physicians) regarding foot disabilities arose from the classification of all weak or abducted feet as flat feet and the attempted division into three degrees. It was productive of tremendous harm among that class of soldiers who were seeking some excuse to escape service or were desirous of a transfer to a non-combat branch of service. It also caused great concern and anxiety to many good officers who worked hard to improve their status and who easily proved their efficiency along military lines, yet who feared for their future record because some uninformed or misinformed examiner had tagged them with a first or second degree flat foot, though the condition, whatever it might be, had never given rise to the slightest symptom in spite of intensive training and work. While in civil as well as in military experience, the most common causes of these mechanical defects were faulty shoes, weak muscles, overweight and faulty standing posture, there exists a fairly numerous class of cases in which there are found some mechanical defects of an anatomic character that have not received the consideration they deserve. These defects concern both the tendinous and the bony structures.

The first of these is a shortened tendo Achillis. Attention has been called to this by various writers, among the first of whom was Shaffer, and it has even been sometimes called "Shaffer's foot," but it has not apparently occasioned much concern among orthopædic surgeons and is an unknown factor to the majority of others. Careful examination of the feet of 50,000 of the recently inducted soldiers showed that about 12 per cent. possessed heel tendons which would not permit of dorsiflexion of the foot to or beyond a right angle when the foot was held straight or slightly adducted and the knee was straight. Examination of the feet of a group of women from various walks of life, entering the nurses' training school of one of our largest Philadelphia hospitals during the past four years, has shown about 30 per cent. affected in this manner. This greatly increased number among women is undoubtedly due to the difference in the height of heel of the shoes of the two sexes, but still it is sufficiently common in each to demand a careful search for its presence and its prompt recognition. The mechanics of its ill effects are due to the downward and backward slope of the os calcis and the attachment of the tendon to the middle and lower portion of the posterior end. Also, in

* Read before the Philadelphia Academy of Surgery, Dec. 6, 1920.

the normal foot, the os calcis points slightly outward from the centre of the ankle-joint, producing a normal tendency to slight abduction. The ill effects of this are counterbalanced by the solidity of the outer bony bulwark of the tarsals and metatarsals and the very short and low arch on the outer side of the foot. When, however, the tendo Achillis is shortened the forward tilting of the leg on the foot in walking throws a tension on this structure which produces one of two effects: either the heel is lifted from the ground as the body swings forward, or it remains on the ground and the foot is rotated outward. The former is more likely to obtain in parallel or inverted foot-walking, and the latter is encouraged in everted foot-walking, and by far the greater majority of persons walk in the latter manner. This outward rotation naturally throws more body weight and strain on the inner side of the foot (the weak side), and mechanical strain from disturbed balance is the inevitable result. One constantly meets with patients (especially women) who claim they cannot wear low-heeled shoes, and before a contrary statement is made, one should make certain that it is not on account of shortened heel tendons.

In a certain camp, a young man just under the draft age, complained of his feet and that he was unable to drill and work as others. He was called "yellow" and "slacker" and was saddled with all sorts of punishment in the effort to get him to train, but to no purpose. He had been examined frequently, but no flat foot or other cause could be found by the surgeons to explain his disability. I was asked to examine him, and as he stood before me the feet were in a position of abduction, though not extremely so. Inspection of the bared feet showed both heel tendons to be so short that the feet could not be dorsiflexed to within five degrees of a right angle. His shoes were balanced and the tendon shortening was neutralized, exercises were given and in three weeks he was drilling actively and spiritedly with his company.

Many similar cases in civil practice could be cited with equally good results following proper mechanical balancing. When strain is relieved, function becomes painless and normal. I have made it a rule of practice to operate upon these cases when under thirty-five years of age by lengthening the tendon subcutaneously by partial section at different levels and thorough stretching and have had uniformly good results from the procedure. After this age mechanical treatment is preferable, as muscle restoration and the resumption of power and function are not so well assured as in younger persons, though, of course, there are exceptional cases of success. It is claimed by some orthopædic surgeons that the tendo Achillis can be stretched sufficiently to relieve this strain by a rocking heel under the shank of the shoe and by massage, exercises and other means. Phelps experimented along this line and the results of his work do not offer much encouragement to stretching of the tendon. Shaffer and Nutt have each constructed a leverage machine in which to

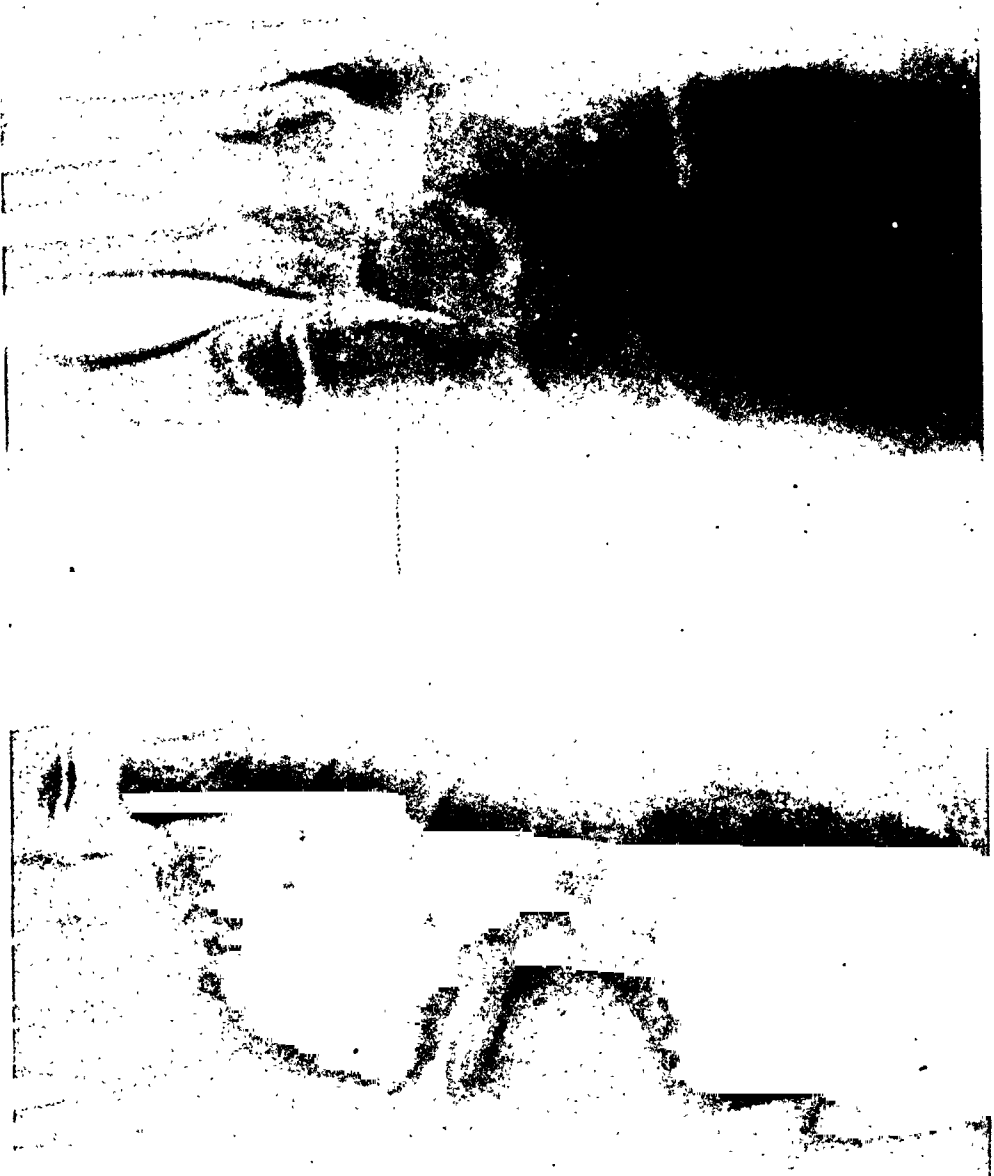


FIG. 1.—Normal relation of the astragalus, scaphoid and internal cuneiform.

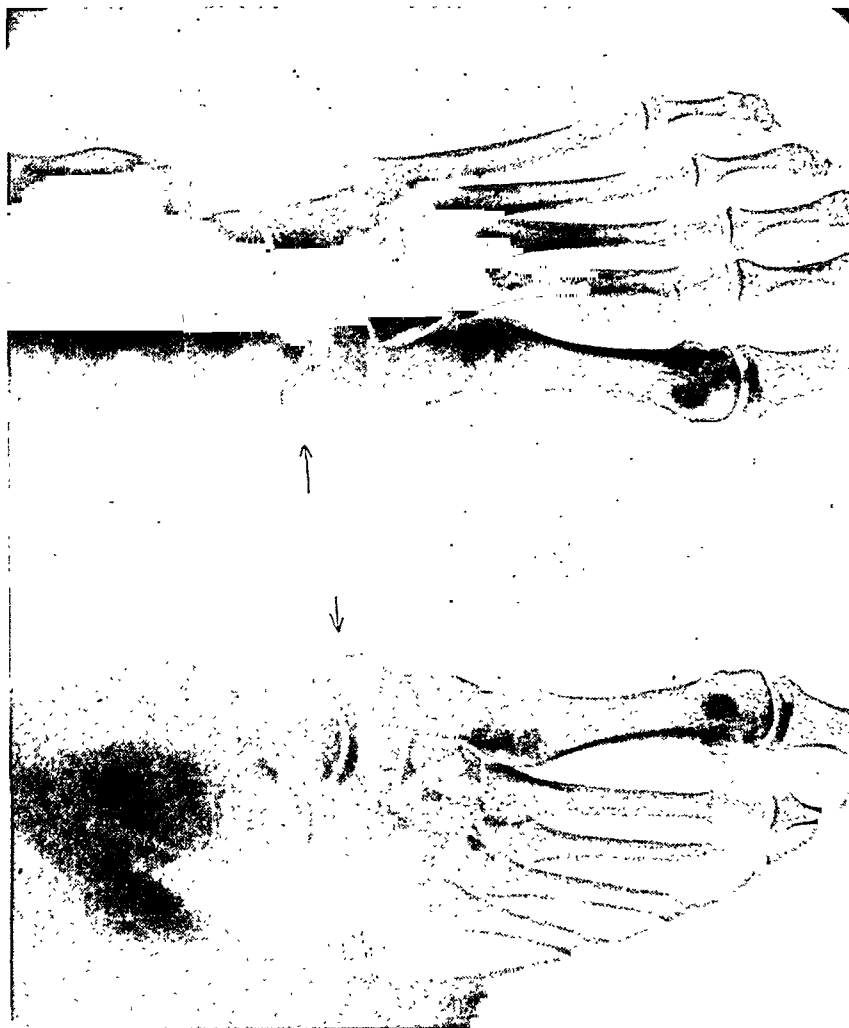
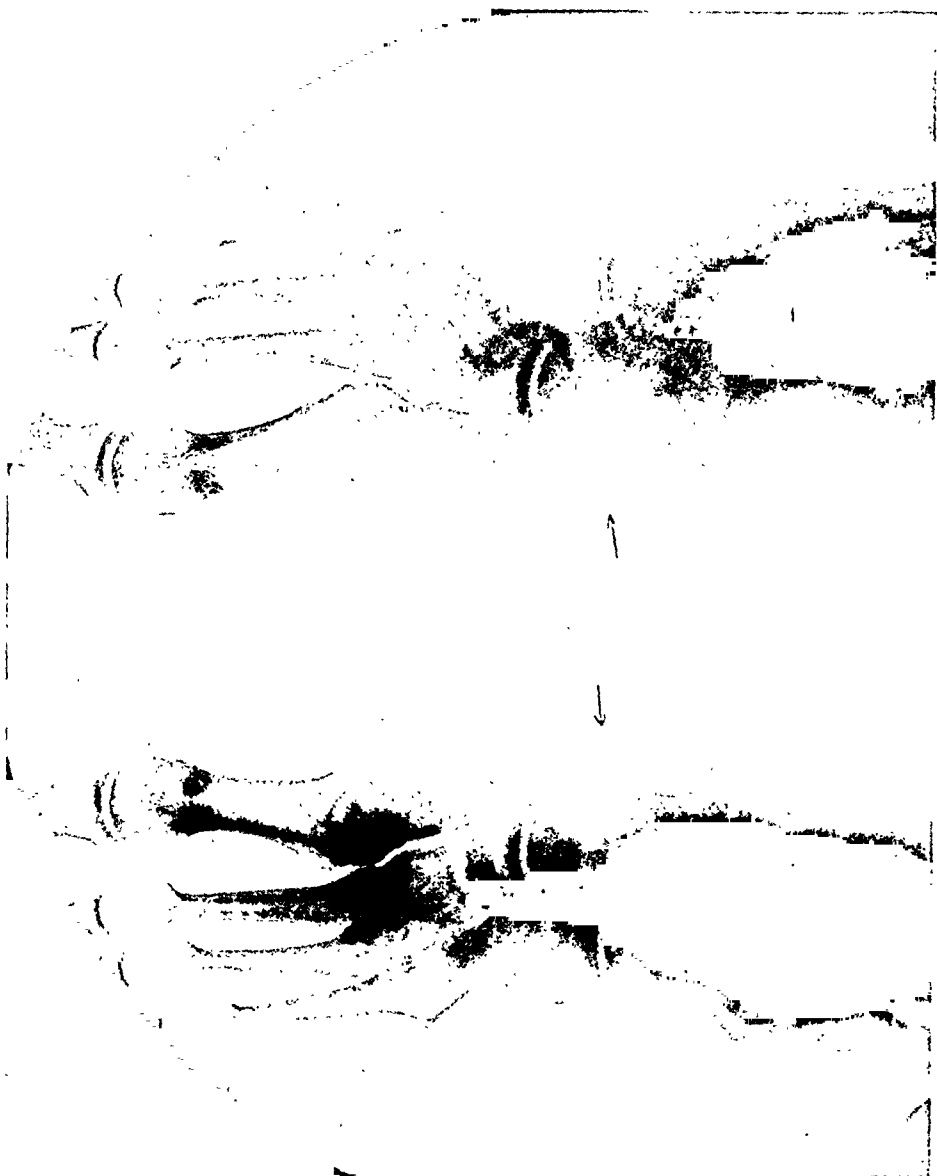


FIG. 2.—Hypertrophy of scaphoid. Abducted feet.

FIG. 3.—One small and one large tibiale externum.



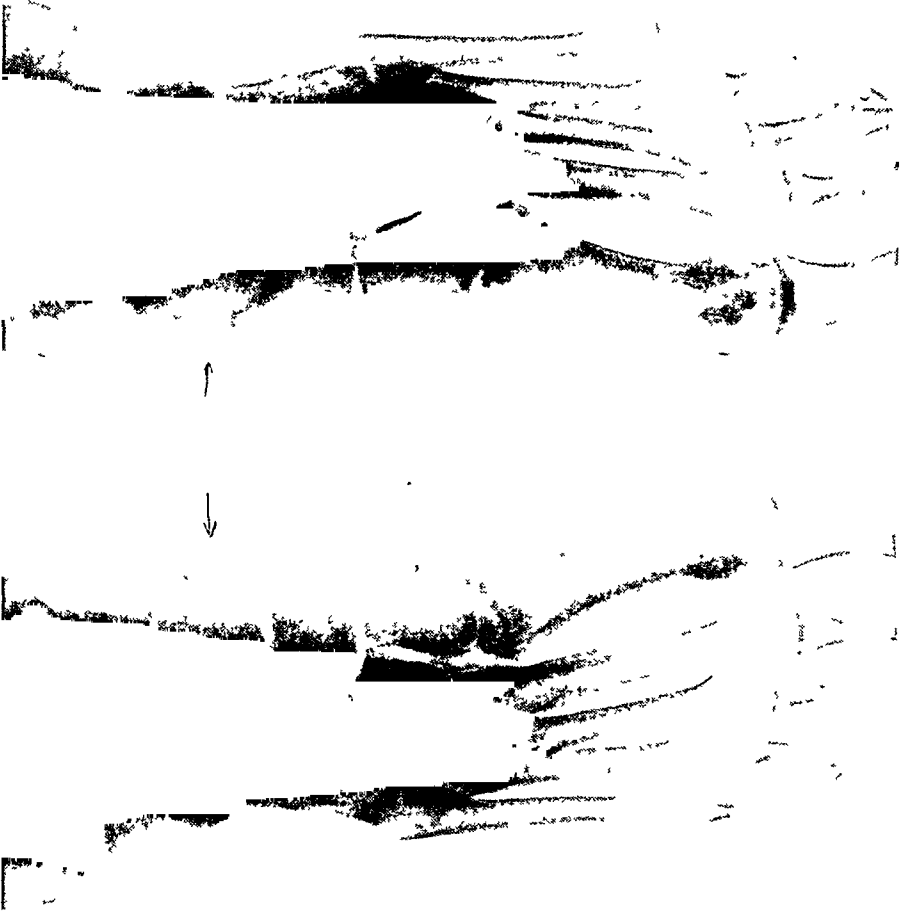


FIG. 4.—Two large tubercle externum in a bad case of flat feet.

THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET

strap the foot for the purpose of stretching the tendo Achillis, and both have claimed excellent results in these cases of right-angled contraction. Personally, I have never succeeded in elongating one by any shoe alteration or mechanical device and am dubious of its accomplishment, except where the shortening has recently followed wearing of a high-heeled shoe and the fibrous elements have not yet undergone organic change. The simplest and best mechanical device is the elevation of the heel of the shoe or the insert of a pad inside of the shoe under the foot-heel. It is well known that a shoe-heel cannot be raised or lowered more than $\frac{1}{4}$ inch, without interfering with the lines of the shoe and throwing strain upon the vamp, but a higher-heeled shoe may be prescribed and worn. Also the shoe-heel should not be more than $1\frac{1}{2}$ inches high in its entirety, as more than this disturbs too greatly the proportion of weight-bearing between the heel and ball and gives rise to other disabilities of as great severity. Frequently it may be advisable to combine with the heel elevation a wedging of the inner edge of the heel and sole to secure adduction of the foot and so throw the body weight directly over the centre of the foot. This again restores balance which is so essential to healthy function on the part of the foot. I have frequently been asked why this wedging could not be done by means of an insole placed inside the shoe, but experience shows that it will not provide the degree of stability and efficient support that the other method does.

The next condition that mechanically predisposes to a weak or flat foot is a hypertrophy of the inner end of the scaphoid bone. When this occurs, the inner border projects inward beyond the line from the border of the head of the astragalus to the internal cuneiform and curls backward along the inner side of the astragalus. In these cases, the articulating surface of the head of the astragalus will often be found to extend further backward on the neck than normally. Dwight, in his atlas of "Variations of the Bones of the Hand and Foot," draws attention to this variation in the shape of the scaphoid and speaks of its fairly frequent occurrence. In the well-balanced foot (Fig. 1) the inner edge of the head of the astragalus and the border of the scaphoid and of the internal cuneiform are in a nearly straight line, but if the scaphoid is prolonged inward (Fig. 2) it forms, by its relation with the inner surface of the head and neck of the astragalus, a mechanical obstruction to adduction of the forepart of the foot. This enlargement is easily felt under the skin, and is commonly mistaken for the head of the astragalus. It can, however, be readily felt to move independently of the astragalus when the forefoot is abducted and adducted. An anteroposterior view of the tarsals with the X-ray will show at once the relations of the two parts. This view must be taken with the feet straight, neither abducted nor adducted, to bring out the accurate conditions of the bones. Attempted adduction of the front part of the foot will be found to be limited by the impingement of the elongated process of the scaphoid upon the head and neck of

the astragalus, and when the foot is thus adducted the process completely covers the head of the astragalus on the inner side. In this position the foot frequently turns inward but little beyond a straight line. The tendon of the tibialis posticus muscle is attached to this portion of the scaphoid, and the insertion covers the entire inner surface of this bone. In this relation of the bone, there is a mechanical disadvantage in the pull of this muscle and its ability to hold the foot in adduction. This disturbance of this pull readily permits a slight degree of abduction, throws a strain upon the remaining structures of the arch and predisposes to the onset of a weak and ultimately of a flat foot. In all of these cases the outward excursion of the forefoot (abduction) is greater than the inward, and when the strain once begins the muscle spasm sets in and the pull of the peronei becomes a very important and very potent factor in the increase of the faulty posture. Walsham and Hughes ("Deformities of the Human Foot") state that, "on the lower part of the convex inner border of the foot (flat foot) may be seen two prominences, the enlarged tubercle of the scaphoid and the head of the astragalus, the prominences being due partly to displacement of the bones and partly to enlargement from chronic periostitis and osteitis, the result of pressure. These prominences are sometimes almost fused together so as to give the appearance of a single prominence, but with a little care a groove between them can always be detected with the finger." In all my cases I have found but one of osteitis, and in that one there was no alteration of position or evidence of weakness. The X-ray does not show inflammatory enlargement of these parts and in those cases operated upon there has been no appearance of inflammation. I believe both of these prominences, therefore, are developmental in character and that when present they have been the determining factors in producing foot strain. In conjunction with these cases it must be remembered that the angle of the neck of the astragalus with the body is also important. When this inclines inward, it increases the tendency to sinking downward of the ankle-joint and internal malleolus, and this hastens the position of weakness and aggravates the disability. I have observed this alteration in many X-ray plates as well as in museum specimens and its importance as a sprain-producing factor must be recognized when it is present.

The third factor which I find frequently, especially in cases of congenitally weak and in flat feet, is a supernumerary tarsal bone placed at the inner side of the scaphoid and over which runs the tendon of the tibialis posticus. This bone is called the tibiale externum and by some has been called a sesamoid in the posterior tibial tendon (Figs. 3 and 4). Dwight ("Variations of the Bones of the Hand and Foot") calls attention to the bone and shows illustrations of anatomic specimens of its various manifestations. It is developed by a separate centre of ossification and may be entirely separated from the scaphoid, looking like a rounded sesamoid; or it may articulate with the inner end of the scaphoid,

THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET

having distinct joint structures between them; or it may have a synostosis with only a thin line of cleavage; or it may be firmly fused with the scaphoid, forming a hook-like projection along the inner side of the head and neck of the astragalus. Dwight says, "The tibiale externum is commonly known as the sesamoid in the tendon of the tibialis posticus, but it is a true part of the skeleton, being found in many mammals and being cartilaginous in the second month of the embryo." "It is sometimes quite free, having no close connection with the scaphoid, but, as Pfitzner has shown, it is never inclosed in the tendon." Recently, in operating upon a case of flat foot in a boy seventeen years of age, I found a large-sized tibiale externum lying on the under surface of the posterior tendon after this tendon had been separated from its scaphoid attachment and reflected back to permit removal of the hypertrophied inner end of the scaphoid. It was removed without disturbing the continuity of the tendon.

When this structure is present and there is marked abduction of the front portion of the foot with prominence and convexity on the inner side of the foot in front of and below the internal malleolus, the best procedure is remove the supernumerary bone and the inner end of the scaphoid and make a reattachment of the tendon of the tibialis posticus further forward on the scaphoid or even to the internal cuneiform. After their removal, the foot can be adducted further, but in older cases it may be necessary to thoroughly stretch the structures on the outer side of the foot and even to cut the peroneus longus and brevis tendons, before sufficient adduction can be secured. A subperiosteal implantation of the tendon is made, and it is better to strip off a thin layer of bone with the tendon when separating it from the scaphoid, as this will insure more firm and reliable union for future strain. The foot is held in plaster of Paris ten to twelve weeks in the adducted position until full correction and safe healing have obtained, and when the patient begins walking the shoe must be tilted by a wedge of about $\frac{1}{4}$ inch in thickness on the inner edge of the heel and sole to guard against strain. This alteration must be worn until the muscles have regained their full tone under proper exercise when the case can be permitted to proceed normally.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY
JOINT MEETING WITH
PHILADELPHIA ACADEMY OF SURGERY

December 8, 1920

DR. WILLIAM A. DOWNES in the Chair

PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

DR. EUGENE H. POOL presented a man whose history is related in a paper read by him, entitled "Pericardiotomy for Suppurative Pericarditis," for which see page 393.

DR. HOWARD LILIENTHAL presented a man upon whom he had operated twenty-one years ago for suppurative pericarditis following pneumonia. At operation the pericardium was found very much thickened. The operation was performed in very much the same way as described by Doctor Pool, with the exception that a tube was not used except to wash out the pericardium. The details of the case were published in the *Medical and Surgical Reports of Mount Sinai Hospital*, 1899. According to the man's statements, he is now perfectly well, and Doctor Lilienthal said that though he had not had the opportunity of making an examination recently the man was apparently in perfect health.

DR. ROBERT GRIER LECONTE, of Philadelphia, said the points which Doctor Pool had emphasized seemed to be the correct surgical ones to bring out. But it must not be forgotten that in post-mortem statistics of pneumonia and other grave diseases, suppurative pericarditis might be present when the symptoms in life were masked or not sufficiently prominent to permit of diagnosis. In the second place, it might not have been the cause of death, but only a participant in final dissolution, so practitioners should not be blamed for bringing few patients with pericarditis to the surgeon. Some years ago, Doctor LeConte said, he had been interested in studying the relation of the pleuræ and the pericardium on the right and left sides, and the studies he had then made were illustrated in the pictures which Doctor Pool had shown. The only way of attacking a suppurative pericarditis was to always drain the dependent portion of the sac. Doctor LeConte stated that the first case in which he performed pericardiotomy was in 1900. In that case he resected the fourth and fifth costal cartilages and dissected up the triangularis sterni, which gave a free exposure without wounding the pleura. One could sometimes see the fold of pleura covering the pericardium, but often it was obliterated

by the inflammation, so one could not count upon finding it. The position of the heart within the pericardium would depend upon adhesions taking place prior to the distention of the sac with pus, and therefore before making a puncture the heart should be located with the fluoroscope to prevent injury with the needle. Puncture should be made as near the sternum as possible, in the fifth or sixth interspace, to guard against traversing the pleura. For diagnostic purposes withdrawal of some of the fluid was as necessary as in empyema. When the pericardium was opened no annoyance was caused to the great vessels by gently manipulating the heart and freeing it from adhesions. This freeing of adhesions with draining of the posterior area would probably prevent pocketing or loculation later.

Doctor LeConte said he had never used Dakin's solution in the pericardium, but he believed it was just as applicable to the pericardium as to the pleura, and he saw no reason why we should have a different procedure in the one than we did in the other.

DR. GEORGE P. MULLER, of Philadelphia, said that he was in particular agreement with Doctor Pool as regarding the necessity for drainage at the dependent part of the pericardium. The method of exposure advocated by Doctor Pool was very satisfactory. He did not think that suppurative pericarditis was particularly common except in association with certain forms of empyema. He had seen five cases only and one was operated upon. Two others were not recognized until too late, and in one case timidity on the part of the physician in charge prevented drainage.

With regard to the recess behind the left auricle, considerable space was given to this pouch by Ballance in his recent book on the surgery of the heart. Doctor Muller also had noted that in Doctor Pool's earlier paper much was made of a case in which at autopsy an undrained abscess was found in the heart sac and behind the left auricle. According to Ballance, even dependent drainage would not reach this recess, and he advocated anterolateral drainage, but it was difficult to see how such could be accomplished without seriously threatening the integrity of the pleural cavity.

Doctor Muller offered the following case for the record: A boy sixteen years of age, with a previous history of diphtheria and rheumatism and frequent attacks of tonsillitis two years previously. He was well until two weeks before admission (May 31, 1915) to the University Hospital, at which time he complained of dyspnoea, palpitation and swelling of the ankles. There was a dull pain over the liver and heart, and cough. The pain was worse on inspiration. The boy thought the symptoms came on shortly after lifting a heavy weight. Physical examination of the chest revealed cardiac dulness as beginning at the second rib and extending to the upper border of the sixth, being greatly widened to right and left. The apex beat was noted in the fourth interspace within two cm. of the limit of dulness. There was a blowing systolic murmur at the

apex, but no arrhythmia. In the third interspace there was a to-and-fro friction rub. The blood count showed 16,000 (71 per cent. polymorphonuclears) leucocytes. X-ray examination revealed the presence of a large pericardial effusion.

Operation was performed in the University Hospital, June 5, 1915. Intratracheal ether anæsthesia was employed. An oblique incision three inches long was made to the left of the sternum over the sixth rib. One inch of the cartilage of this rib was removed. The muscles were pushed aside and the pericardium grasped, opened and its cavity explored. Several ounces of the bloody serum were evacuated and the heart found lightly adherent to the pericardium. About six more ounces were evacuated after separating these adhesions. Arrhythmia and extra systoles were noted when the heart was touched. A rubber tube was sutured into the pericardium projecting inwards about one inch and the wound closed around it. The recovery was uneventful, and nine days later the tube was removed and not replaced. The fluid evacuated was found to contain many pus-cells and blood-cells; it was examined bacteriologically, but unfortunately this was not attached to the record.

DR. WILLY MEYER reported a case of chronic inflammation, a sero-sanguino-fibrinous pericardial effusion, in a tuberculous patient, thirty-three years of age. This patient was operated upon at the Lenox Hill Hospital in 1908. The left pleural cavity had been repeatedly aspirated and large quantities of clear serous fluid evacuated. The X-ray examination showed an enlargement of the pericardium and aspiration was performed by him. The puncture was made in the fifth intercostal space, close to the sternum, and 1200 c.c. of a dark fluid evacuated. The patient improved at once, but in one week a second aspiration was required, and 1000 c.c. withdrawn. After six days incision and drainage were absolutely indicated. In doing the operation the same method mentioned by Doctor Pool and Doctor Lilienthal was employed. Under local anæsthesia the sixth and seventh costal cartilages were resected and the internal mammary vessels tied and cut to get the proper access. The pleural cavity was first tapped and then the parts were pulled aside and an incision made into the pericardium. More than two quarts of fluid were evacuated. A drop-light was then used to inspect the pericardium, and the finger introduced to feel the heart beat. No pulsations could be made out. Then with stick sponges large quantities of fibrinous material were removed. The fingers now again introduced into the pericardium could feel the heart pulsations. Often in these cases of chronic effusion very large amounts of fluid were present (quarts) which was easy to understand, as the mediastinum could expand bilaterally as well as posteriorly. The first thing to be carried out in these patients after the usual clinical examination was an X-ray examination; then the aspirating needle should be used. Repeated aspiration was contraindicated; free incision of the pericardium with thorough drainage should always be

made, and fibrinous coagulations, as found in chronic effusions, thoroughly cleared out.

Doctor Meyer stated that he had seen this patient one year after the pericardiotomy was performed and he was then in very good condition. He was presented with the wound healed before the Surgical Society in 1909.

DR. WILLIAM DARRACH reported a case of suppurative pericarditis occurring in a very sick negro. Drainage was instituted under local anæsthesia with considerable difficulty. The man returned later with pericardial adhesions and general anasarca, and died.

DR. JOHN H. JOPSON, of Philadelphia, spoke of the use of the Carrel-Dakin method in the pericardium. He had operated on a young man last spring, who had what proved to be a general staphylococcus infection, beginning in the accessory sinuses. Admitted to the Presbyterian Hospital when very ill, a laryngologist operated upon him for this, and later Doctor Jopson was called to see the patient for a suspected pleural involvement. After two weeks an empyema developed on the right side, also of staphylococcic origin. This was drained under local anæsthesia. Soon after the boy began to suffer from cardiac embarrassment, and the X-ray showed a large pericardial effusion. At operation under local anæsthesia a single costal cartilage, the fifth, was resected. Doctor Jopson said he then began to use the Carrel-Dakin treatment with some trepidation. The empyema on the right side was simultaneously Dakinized. The left pleura was aspirated several times for a reaccumulating collection which remained serous. The Dakin solution was badly borne in the pericardium, and caused cardiac embarrassment, the fluid apparently being too thick and gelatinous after mixing with the pus, and it had to be given up. The patient made a strong fight for life, and finally died after an illness of more than eight weeks. An antistaphylococcic serum was also used. Doctor Jopson expressed the opinion that the method of drainage described by Doctor Pool was a most valuable one, superior to any hitherto described, and would certainly replace the old method of single cartilage resection which gave poor drainage, while this was ideal. The Carrel treatment failed in his case because of the absence of dependent drainage which was advisable here.

GASTROENTEROSTOMY IN PERFORATING ULCER OF THE STOMACH

DR. JOHN B. DEAVER, of Philadelphia, read a paper with the above title, for which see page 441.

CHOLECYSTO-DUODENAL FISTULA AND ULCER OF THE LESSER CURVATURE

DR. JOHN F. ERDMANN presented a man, fifty-three years of age, who one year ago began to suffer from abdominal distress four to five hours

after eating. Later he began to vomit. The vomiting had existed for the major portion of the past year and consisted of mucus to food taken the day before. There had been a slight loss in weight—five to seven pounds. He had never had any severe pains, never been bedridden, and never been conscious of losing blood, either by mouth or rectum.

November 6, 1920, he was operated upon for ulcer of the duodenum. Upon exposure it was found that profound adhesions existed between the gall-bladder and duodenum with calculi in the gall-bladder and a fistula between an old perforated duodenal ulcer and the gall-bladder. In addition, an ulcer of the size of a twenty-five-cent piece was disclosed upon the lesser curvature and posterior wall of the antrum. The appendix was atrophied. A cholecystectomy was done, in addition to closing the duodenal ulcer opening, and a typical Balfour excision of the gastric ulcer. The appendix was not disturbed.

DUODENAL FISTULA FOLLOWING CHOLECYSTECTOMY, WITH FOREIGN BODY

DOCTOR ERDMANN presented a woman, thirty-nine years of age, who was seen by him October 14, 1920. She gave a history of having been operated upon for gall-stones and appendix in New York City on May 26, 1920; again on June 1st, ostensibly for adhesions, with pus and bile leakage, accompanied with chills and fever; again on August 19, 1920, for a pus pocket. On the day Doctor Erdmann saw her she presented a fistula in the right upper quadrant, but no apparent bile. She stated that she had at one time discharged what looked like coagulated milk. There had been no chills since the third operation. She had lost forty pounds in weight. She said that her operating physician had to pack her wound during the second operation because of bleeding. She had required two dressings a day to keep her comfortable. A diagnosis was made of intestinal fistula, or foreign body.

A few hours before operating upon her Doctor Erdmann was called by telephone and advised by another physician that he had assisted at the third operation and removed quite a piece of gauze. Operation, on October 19, 1920, revealed dense adhesions. The sinus enlarged as deep approach was made. No gall-bladder was present. A foreign body, a piece of gauze, rolled like a cigar, four inches long and one-half inch in diameter, and foul smelling, was found. Removal of this revealed a hole, with indurated and irregular edges and large enough to admit a silver quarter, in the upper surface of the first portion of the duodenum.

Suture of the opening was made in three tiers, and a gastroenterostomy was done. The patient was discharged from the hospital in twenty-nine days, with only a small spot of granulation at the site of the original drain.

PERFORATED GASTRIC AND DUODENAL ULCER

ABDOMINAL SINUS; SUBPHRENIC ABSCESS; CHOLECYSTO-DUODENAL FISTULA

DOCTOR ERDMANN presented a woman, fifty-one years of age, who was first seen by him September 22, 1920. One year before, in Nebraska, she had been operated upon for gall-stones, remaining three months in the hospital. She left the hospital with a persisting fistula. In November, 1919, she went to Rochester, Minnesota, and while under observation there her fistula closed. She was told by one of the physicians to return in a year to have her gall-bladder removed. Two months before seeing Doctor Erdmann she began to have pain in the operated region, and in a few days the old sinus reopened and discharged pus and blood. She had lost considerable weight and presented the appearance of secondary anæmia, characteristic of malignancy. There was a most foul, brownish, free discharge from the sinus, which she stated required from two to five dressings a day. No bile color observable.

While under observation in the Post-Graduate Hospital she ran a temperature of from $99\frac{1}{2}^{\circ}$ to 103° per rectum. She was anæmic, with a blood count of 3,500,000 red-cells; hæmoglobin, 47; no marked differential.

Operation (October 1, 1920) revealed an atrophied gall-bladder well below the liver border, densely attached to the colon, with a perforation into the duodenum, and a large subphrenic abscess holding over two pints of gray to brown pus, most foul smelling. The gall-bladder, upon removal and section, showed the half of a large white grape in it. The duodenal connection was closed. The subphrenic abscess was drained into the midaxillary line and through the abdominal wound. The patient was discharged from the hospital in five weeks with a small sinus in the right axillary line.

PERFORATED GASTRIC AND DUODENAL ULCER

DR. CHARLES H. PECK presented two cases, illustrating operative results in cases of perforated gastric and duodenal ulcer. The first case was that of a man upon whom Doctor Peck had operated for perforated duodenal ulcer in 1904. The operation was performed four hours after the acute onset of symptoms and consisted in a suture of the ulcer without gastroenterostomy. The man made a good recovery. He was followed up for a number of years, during which time he was in good health; he was then lost sight of until February, 1919, when he presented himself, complaining of a recurrence of ulcer symptoms, from which he had been free for a period of thirteen years after simple closure without gastroenterostomy. He now presented evidence of duodenal stricture as shown by the X-ray and corroborated by physical signs. A posterior gastroenterostomy was performed in February, 1919, almost two years ago. Doctor Peck said he presented this patient to illustrate the end-result in operation for ulcer, in the first place, and in the second place, because of the long interval that might exist before the development of a stricture

which required further treatment. There was nothing special in the detail of the case, it being a typical case of ulcer at the time of onset.

The second case also had an interesting and prolonged history. This patient Doctor Peck operated upon in 1907, thirteen years ago, for an acute perforation on the anterior wall of the stomach. The perforation was at the middle of the anterior wall; closure was effected by a simple suture without gastroenterostomy. Following this operation the patient went along in fairly good health until 1911, when she presented herself, complaining of indigestion and gastric pain and distress. The X-ray examination showed a typical hour-glass stomach, for which an anterior gastrogastrostomy, giving nearly four fingers' opening, was performed in January, 1911. The patient made a good recovery and was relieved of her symptoms for a few months. In September, 1911, she was operated upon for an acute gangrenous appendix which had perforated with the formation of a retrocæcal abscess. At both previous operations she had been so seriously ill that they had not thought it advisable to prolong the operation by performing an appendectomy. In 1915 she complained of some chronic indigestion and returned to the hospital, where an X-ray examination was made which showed the gastrogastrostomy functioning well with a broad opening which had not contracted much in the meantime. She suffered a certain amount of gastric distress in 1916, but this passed on without further operative treatment, and she was now comfortable and in good health.

DR. ASTLEY P. C. ASHHURST, of Philadelphia, said he agreed with Doctor Deaver in practically everything he had said, but he regretted that he had not told how many patients died without operation, for those deaths should be added to the mortality statistics. It was not so much the mortality from operation as the number of deaths from the disease that should concern us. He thoroughly agreed that it was proper to do a primary gastroenterostomy in perforated ulcer if the patient's condition permitted.

DR. CLARENCE A. MCWILLIAMS said that he had looked over the records of the Presbyterian Hospital for the past four years and found that there had been a total of twenty-one patients admitted with perforated gastric and duodenal ulcers, four of whom died after operations, or 18 per cent. Nine of this total had immediate, primary gastroenterostomies performed with two deaths, or 22 per cent., while twelve had not had gastroenterostomies, of whom two died, or 17 per cent.

It was unquestioned that those upon whom gastroenterostomies were performed were picked as the best risks, consequently the mortality was sure to be greater in those upon whom a gastroenterostomy was indiscriminately performed than those without. The after-results are interesting. There were twelve cases which had no gastroenterostomy at the primary operation, two of whom died, leaving ten to be followed; of these ten, two were cured, or 20 per cent.; two were improved, or 20 per cent.; while six were unimproved, or 60 per cent.; three of these unimproved

six had subsequent gastroenterostomies without mortality and one had a subsequent perforation with death resulting after operation. Consequently, it could be said that the after-results were not brilliant among those upon whom no gastroenterostomy was done. Of the nine cases with primary gastroenterostomy, the after-results were too few to be illuminating. Of these nine with primary gastroenterostomy, two died as a result of the primary operation, leaving seven to be followed; of these seven, three were cured, or 42 per cent., while four could not be followed.

From these small statistics, the position of Doctor Deaver, as to the poor after-results, seemed to be confirmed. It certainly might be wise for the expert to add a gastroenterostomy, provided the operator thinks the life of the patient would not be jeopardized. The casual operator, however, had better not yield to the temptation to do a gastroenterostomy. It would seem to be a mistake to lay down the dictum that every perforation of a stomach or duodenal ulcer must have a gastroenterostomy at the primary operation, for this would be followed by an unnecessarily higher mortality. Stenosis of the pylorus caused by the infolding of the perforation is usually regarded as an indication for a gastroenterostomy, yet even this is not an absolute indication, for nature overcomes a considerable constriction of the pylorus. This is shown by the large number of statistics collected from many sources by Doctor Eliot, in which it was proved that in only one or two instances among the entire series was a gastroenterostomy necessary within a few weeks of the primary operation performed for acute perforation. Whether the slightly increased mortality attendant upon a primary gastroenterostomy would be offset by the mortality following the secondary operations required in a certain proportion of cases to effect a cure, a large number of cases alone would tell. So far as perforations of gastric ulcers alone were concerned, a secondary operation would allow a procedure to be performed which would be more certain to cure than a gastroenterostomy, namely, pylorotomy, if the ulcer were near the pylorus.

PERFORATED ULCERS

Total, 21 cases, 4 deaths, or 18 per cent.

1. Without gastroenterostomy—12, 2 died, or 17 per cent.

2. With gastroenterostomy—9, 2 died, or 22 per cent.

A. Gastric, 11, with 1 death, 9 per cent.	{	With gastroenterostomy, 5; 1 death.
		Without gastroenterostomy, 6; 0 deaths.
B. Duodenal, 10, with 3 deaths, 30 per cent.	{	With gastroenterostomy, 4; 1 death.
		Without gastroenterostomy, 6; 2 deaths.

AFTER-RESULTS

With primary gastroenterostomy, 9 cases.	{ 2 died. 3 cured. 3 could not be followed. 1 too early to be followed.
Without primary gastroenterostomy, 12 cases.	{ 2 died. 2 cured. 2 improved. 6 unimproved, 3 of whom had subsequent gastro- enterostomies, while 1 had a subsequent per- foration, with death after operation.

DR. ELLSWORTH ELIOT, JR., said that, if Doctor Deaver referred to a paper he had written some years ago, he erred in his statement that seventy-five instances of secondary operation after a primary suture of a gastric or duodenal ulcer were cited. The number of these cases was much smaller; in fact, their percentage was not as large as in those cases collected in which there was trouble after a gastroenterostomy without perforation. Some of these latter patients had so much trouble that the gastroenterostomy had to be revised and some other operative measure applied for the relief of the ulcer. Doctor Eliot said he would agree that in perforated ulcer primary gastroenterostomy done by Doctor Deaver's skilful hands, or by hands equally skilful, would not add to the mortality of the operation, but it was perhaps unwise to induce the surgeon of less dexterity to prolong the operation in this way, for under certain circumstances it might easily jeopardize the life of the patient. In a questionnaire, in connection with the paper referred to, sent out to a number of surgeons, chiefly members of the American Surgical Association, asking their opinion in reference to the performance of primary gastroenterostomy in cases of perforated ulcer, a number answered that they were convinced that the prolongation of the operation necessary for the addition of gastroenterostomy resulted in additional fatalities. The consensus of opinion seemed to be that it was safer to limit the operation to closure of the perforation, and, subsequently, if necessary, to do a secondary gastroenterostomy. Usually a secondary operation was not required, or if required it might be, as in Doctor Peck's case, many years after the closure of the perforation. A secondary operation could be done with much less risk, particularly in relatively unexperienced hands. In recent perforations without extensive peritonitis, and in skilled hands, a primary gastroenterostomy was frequently justified, but in delayed cases coming to the surgeon twenty-four to forty-eight hours or later after the perforation with extensive peritonitis, the patient's chances of

recovery are better if the perforation is merely closed. If the patient recovers and the gastric symptoms persist, a secondary gastroenterostomy can then be performed. It is interesting and important to note that the secondary operation is rarely necessary, if at all, before the expiration of several months, and frequently much later. Doctor Eliot said so far as he knew it had never been performed before the tenth day. In other words, the gastroenterostomy is done, if indicated, after the patient has fully recovered from the effect of the primary operation.

DR. JOHN F. CONNORS agreed with Doctor Deaver in all the things he said, but took exception to the performance of a gastroenterostomy in perforated ulcer as a routine measure. He cited the following statistics from a paper he had published in 1916 in which he presented an analysis of forty-two cases of perforated ulcer. Since that time there had been twelve additional cases. Of these cases 72 per cent. were simple closure by suture. In these cases 70 per cent. recovered and 30 per cent. died; in 28 per cent. of the cases a gastroenterostomy was performed at operation; 33 $\frac{1}{3}$ per cent. recovered and 66 $\frac{2}{3}$ per cent. died. In many of the cases which were done by suture he felt that in a large number he had lessened to a great extent the calibre of the pylorus, and it appeared at the time of operation that little if anything could pass through, but in only two of them was it necessary to perform a gastroenterostomy at a later date; one after six weeks and the other three months.

Doctor Connors said he had seen two of the cases closed by suture, one after three years, which died of pneumonia; at autopsy there were absolutely no evidences of ulcer to be found. The other was a patient who had an active tuberculous condition of the lung at the time of his perforation. He was operated two years later for a tuberculous peritonitis and no evidences of ulcer were to be seen.

Doctor Connors said that gastroenterostomy in the hands of Doctor Deaver was a safe procedure, but Doctor Deaver had well said "in the hands of a master"; unfortunately, most of us were not masters but unskilled. Therefore, he maintained that simple suture was the operation in perforated gastric ulcer.

DR. CHARLES H. PECK said that when he looked over the series of perforated ulcers for the past eight years, on the Second Surgical Division of the Roosevelt Hospital, he found twenty-one cases, and these histories showed that they had frequently done primary gastroenterostomies. If a primary gastroenterostomy implied an additional surgical risk it was left for a secondary operation. In making the decision as to whether or not to do a primary gastroenterostomy it made a great deal of difference in what condition the patient was and how long a period had elapsed since the perforation. In this series of twenty-one perforations, there were twelve primary gastroenterostomies and nine simple closures. There were three deaths in the first series, a fairly high mortality. In the cases closed without gastroenterostomy there were many which were

severe cases. Doctor Peck said he believed gastroenterostomy could be done safely in many early perforations where there was not much soiling; it could be done quickly without causing much shock to the patient, and the chances for a permanent cure were distinctly better.

Doctor Peck recalled a perforation operated upon in 1909 after twenty-nine hours, when the abdomen was full of exudate. That woman could not have stood gastroenterostomy. He had followed her for fourteen years and she had remained perfectly well without a secondary operation, and without the persistence of gastric symptoms. On the other hand, there were some cases requiring secondary operation. There were four cases requiring secondary gastroenterostomy, one fifteen years after the perforation; another eleven years after, in both instances with a good interval of freedom from symptoms. The two others required the secondary operation within shorter periods. In one of these, a man seventy-one years of age, a second operation was required within twenty-one days. This patient had a fixed duodenum and an attempt was made to suture the perforation, with the result that a fistula formed which closed in about three weeks, with complete closure of the pylorus. At this time he was in a desperate condition physically, and demented also. He was now seventy-four years old and well. In another case the secondary operation was done thirty-two days after the first. In a good many cases if it could be done without increasing the mortality an immediate gastroenterostomy had its advantages, but, on the other hand, there are a good many cases in which fifteen or twenty hours after perforation there was a good deal of exudate and it was better policy to close the perforation and take a chance of having to do a secondary gastroenterostomy.

DR. JOHN A. HARTWELL said that one got the impression from the paper and the discussion that statistics on this subject were of very little value, as they varied so much in the different clinics. He felt that one could scarcely lay down a rule of practice, but that each case must be considered on its merits. He had understood Doctor Deaver to say that he had never seen a perforated ulcer that could not be properly closed, and he wondered that if possibly some of the deaths reported had not been due to the failure of union or an incomplete closure, with a resultant peritonitis.

Another point brought out by Doctor Hartwell was that the production of gastroenterostomy was not a natural procedure, and a person with a gastroenterostomy was not a normal person. He had gone on the principle that the surgeon who performed a gastroenterostomy must show cause why he should do it. In other words, a gastroenterostomy was not something to be done because it was convenient, but one must show why it was a good thing. If there was an obstruction at the pylorus after the perforation was closed, then gastroenterostomy should be considered. If the patient was in good condition and there was reason to think the stomach sufficiently deformed so that the musculature would

not properly function, a gastroenterostomy should be performed. Otherwise the stomach should be left in as nearly a normal condition as possible until subsequent evidence made a secondary operation advisable. Gastroenterostomy in itself was justly considered as largely a curative measure for pyloric and duodenal ulcers. It, however, was not curative for gastric ulcers, and hence the necessity of its employment in gastric perforations was less apparent than in duodenal perforations.

DOCTOR DEEVER, in closing the discussion, said that, speaking of the surgeon with large experience and of the occasional surgeon, the occasional surgeon should not do a posterior gastroenterostomy as a routine procedure. Most of their posterior gastroenterostomies were done in early perforations. Patients operated upon after seventy-two hours practically all died whether suture alone was done or a primary gastroenterostomy added. The success of this procedure depended upon its being done early. In diffuse peritonitis few surgeons would perform a gastroenterostomy, but done in the early stage by a well-trained surgeon it was safer than simple suture, because there was less likelihood of leakage, and he believed that was one reason why it had been followed by better results. One must not lose sight of the fact, as one of the speakers had remarked, that from the physiological standpoint it might be better to go on with the stomach in its natural condition, but it must be remembered that many people with posterior gastroenterostomies were just as well as those who had never had anything wrong with their stomachs. The 80 to 90 per cent. of cures recorded by Moynihan, the Mayos, and others followed up, afforded proof of this statement.

BOOK REVIEWS

PARACELSUS: His personality and influence as physician, chemist and reformer. By JOHN MAXSON STILLMAN, Professor of Chemistry, Emeritus, Stanford University. The Open Court Publishing Company, 1920. Cloth, 8vo., pp. 184. Chicago.

For some reason or other Paracelsus has been brought into notice in connection with the development of medicine to a much larger degree than his real worth would seem to merit. No one of the catalogue of medical worthies has been the subject of greater dispute as to his character; by many he has been considered as almost beneath contempt, while by others he has been exalted as a great medical iconoclast, whose privilege it was to usher in a new dawn in medicine. There are some things about him, however, about which there is no dispute. He was a medical tramp, never contented to remain long in any one place. As an army surgeon he had participated in wars in Denmark, Sweden, and Italy. In his further wanderings he visited England, France, Belgium, Portugal, and Spain. He traversed much of Germany, Moravia, Hungary, and Carinthia, visiting many places and remaining long in no place. At the age of thirty-three he reached the summit of his achievements in an appointment as the city physician of Basel and professor in its university. This appointment was due to the influence of the distinguished book publisher, Froben, who had been relieved by Paracelsus of a painful illness which had defied the efforts of many physicians. But a year did not elapse before the storm which his personality and methods and doctrines caused to gather about him was so great as to make him glad to leave Basel and start again upon his peripatetic career. After fourteen years more of wandering, he died September 24, 1541, at Salzburg, in the forty-eighth year of his age.

Portraits of Paracelsus in his later years show him as apparently a very old man, doubtless the result of the irregularities of his life and the tempestuous nature of his mental processes.

Paracelsus was a born fighter. In some respects he reminds us of his theological contemporary, Martin Luther. In his contempt for tradition he suggests to us his other contemporaries, Vesalius and Paré. The elements of his character which dominated his work, however, were the extravagance and positiveness of his claims, the savageness of his attacks upon those who disagreed with him, his overweening egotism which destroyed all proper perspective in his views of men and affairs, which had its fruit in an intense charlatanism in the practical affairs of medicine. Like all charlatans that blow their trumpets loud and long and make claims for abilities which results do not substantiate, it was easy for him to attract immediate notice wherever he went, a notice sure to be turned

into such discredit within a short time that he was glad to soon move on to another place of labor.

There is no reason to suppose that Paracelsus did not believe all that he claimed for himself. It would be interesting if some psychoanalyst of the present day would make a study of Paracelsus as he is revealed in his writings. He was an intense man in all the relations of life. If we study his character and the times in which he lived, we are unable to see in him a great reformer; he belonged to the destructive type rather than to the constructive type of men. He could not have been a very pleasant man to live with.

He was a picturesque character, the product of his times. And his protests against the absurdities of the medical practice of his time, and his suggestions as to the value of simpler and especially of chemical remedies show him to have been a man of vision.

The manuscript works in which his views were set forth were voluminous.

Professor Stillman has given us in this little book an excellent study of all that is known about Paracelsus. During recent years much scholarly research, notably by German writers, has been brought to bear upon the life history of Paracelsus. Upon the results of this research the author has freely drawn. There is no intelligent physician who is interested in the history of his profession who will not gain from this book of Professor Stillman a new and better understanding of the personality, accomplishments, and influence of Paracelsus.

LEWIS S. PILCHER.

DISEASES OF THE EAR. By PHILIP D. KERRISON, M.D., Aural Surgeon to the Willard Parker Hospital for Infectious Diseases. Second Edition, Revised and Enlarged. J. B. Lippincott Company. Philadelphia and London.

Kerrison's admirable work on the diseases of the ear, which was published first in 1913, has just reappeared in an edition with some revisions by the author. From the time of its first appearance the work has continued to enjoy a very wide popularity, its clear and direct style and the comprehensive presentation of the entire field seeming to render it both an admirable text-book and also an excellent work for the specialist and general surgeon for checking up personal experiences. Kerrison's book may be said to have been the first formal American treatise to gather the mass of comparatively newly investigated and research material on the static labyrinth and incorporate it as a part of his treatise. This was carefully done, and its convenient form and thoroughness has met with the approval of otologists very generally. In the section devoted to the labyrinth the author reviews the anatomy of the labyrinth, its physiology as generally accepted, and the grounds on which the modern theories of

its function have been proved; and also labyrinthine diseases and their symptoms, their remedies and the methods of surgical intervention, when the disease is of a suppurative nature and of a type to receive benefit therefrom. It is not surprising that this portion has been in small part revised, since the present-day theories regarding this field are still in process of crystallization. The chapter on the effects of syphilis upon the labyrinth has also been in part rewritten. The writer of this notice of the work can but congratulate the author for the successful presentation of a conscientiously performed, well-proportioned task.

WILLIAM C. BRAISLIN.

SURGICAL PATHOLOGY AND MORBID ANATOMY. BY SIR ANTHONY A. BOWLBY, K.C.B., F.R.C.S., AND SIR FREDERICK W. ANDREWES, M.D., F.R.S. P. Blakiston's Son and Co., Philadelphia, Pa.

The work under consideration consists of one volume containing 651 pages with 210 illustrations, and appears as the seventh edition.

For the undergraduate as well as for the graduate the general plan of the book is excellently adapted for a brief but comprehensive reference on surgical pathology. There are seventy-four chapters of which the first eight deal with hypertrophy and atrophy, degeneration, microorganisms in their relation to surgical pathology, inflammation, suppuration, healing of wounds, surgical fever and inflammatory leucocytosis, supramia, septicæmia, and pyæmia.

Of the next sixty-six chapters, fifty-four deal with diseases most frequently encountered during life. Their natural courses and terminations are briefly related, and the morbid appearances presented by the structures involved are admirably described. In general, one disease, or one pathological condition, as the case may be, is begun and finished in a single chapter. There are, however, three chapters devoted to diseases of the bones and three to diseases of the joints.

The remaining twelve chapters are devoted to the pathology of shock, tumors (four), cysts, contusions, hemorrhage, fractures and dislocations, blood-vessels, nerves, and gangrene.

Most excellent and pertinent plates are numerous throughout the book. There are a few good photomicrographs. Most of the illustrations, however, are devoted to photographs or drawings showing the gross pathology of the lesions under discussion.

Before the presentation of this last edition a complete revision of the older work was accomplished and new drawings were added. Recent war experiences have prompted the addition of fresh chapters on gas gangrene, shock, and tetanus.

The reviewer considers that this work is certainly worthy of its present new edition, and predicts for it a useful and successful future.

MERRILL N. FOOTÉ.

VENEREAL DISEASES, THEIR CLINICAL ASPECTS AND TREATMENT. By I. E. R. McDONAGH, F.R.C.S., Surgeon, London Lock Hospital. William Heinemann, London, 1920.

This is a compendium on venereal disease profusely illustrated with color and half-tone plates. Each plate has beside it a concise description of what is to be seen which greatly assists the reader. It is written by a man who, from his position as Surgeon to the London Lock Hospital, has had abundant experience in every detail, and who has made full use of his great opportunities in observing and recording his impressions. These he has given in an impressive way in the thirty-four chapters in the volume before us.

The various problems concerning the prevention of venereal disease are discussed and the opinion expressed that if it were made compulsory to attend an ablution centre within one hour of exposure, almost a guarantee can be given that infection will not ensue—but his own opinion is that no measure short of one akin to vaccination against smallpox will be really successful in ridding the world of venereal disease.

Syphilis has been gone into very fully and treated in an interesting manner. One of the best short chapters is that on the clinical aspect of syphilis of the nervous system. The writer accepts the view that tabes and G.P.I. are not clinical entities but merely the end-results of a previously undetected lesion. He shows the influence which syphilis of the vessels has on the causation of the purely nervous manifestations, a view which is still further strengthened by the frequent occurrence of degenerative encephalitis following early hemiplegia. The author enters very fully into the treatment and makes careful discrimination between the various methods employed.

The whole volume is well written, the lucid explanations and the concise statements make it eminently readable, and as the information is up to date it makes an admirable volume for students and practitioners.

WILLIAM MACEWEN.

SURGERY: ITS PRINCIPLES AND PRACTICE, FOR STUDENTS AND PRACTITIONERS. By ASTLEY PASTON COOPER ASHHURST. Second edition, thoroughly revised. Lea & Febiger, Philadelphia and New York, 1920.

The second edition of Ashhurst's "Principles and Practice of Surgery" has appeared as a natural sequence to the favor and demand with which the earlier edition was received by both practitioners and students. New matter has been introduced, some sections have been entirely rewritten and the whole text has been revised and brought up to date. Although the volume is somewhat larger than in the first edition, it is nevertheless characterized by the same conciseness of expression and omission of the unessential.

The chapters on reconstructive surgery, infected wounds, empyema,

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and gunshot wounds have been completely rewritten and reflect the author's wide experience and opportunity for accurate observation during the recent war. It is in this field particularly that the greatest advances have been made; not so much in the discovery of new principles but in the understanding and application of surgical fundamentals.

The work as a whole is presented in a scholarly and able manner. It reflects all that is best in modern thought and practice. The text is abundantly supplied with excellent illustrations, most of which are original. The second edition merits the continued approbation of surgeons and students.

WALTER A. SHERWOOD.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

ANNALS *of* SURGERY

VOL. LXXIII

MAY, 1921

No. 5

THE RESULTS OF SURGICAL TREATMENT OF EPITHELIOMA OF THE LIP*

BY WALTER ELLIS SISTRUNK, M.D.

OF ROCHESTER, MINN.

SECTION ON SURGERY, MAYO CLINIC

JUDD and BECKMAN have reported the results obtained in the Mayo Clinic by operations for cancer of the lower lip. The present study was made with the idea of determining the results of a number of years following such operations. I have, therefore, recently reviewed in detail the case histories of the patients operated on during 1912, 1913, and 1914; that is, from five to eight years ago. The results in this group of cases differ somewhat from those previously reported by Judd and Beckman.

In cancer of the lip, as in cancer in other regions of the body, a great difference in results is to be expected in the cases in which the glands are involved at the time of operation compared with those in which operation is performed early, before glandular involvement can be demonstrated. In the group selected for study the best results were obtained in the patients operated on before glandular involvement could be demonstrated and in whom the glands which drain the lip were removed as a prophylactic measure.

Epithelioma of the lip, on account of the ease with which the diagnosis may be made and the ease with which the growth and the glands draining it may be removed, may be classed as one of the most favorable types of malignancy. In spite of these advantages and possibilities, however, one finds, on reviewing the results obtained by operation, that many patients die each year of this disease. These deaths occur primarily because of delay on the part of the patient in seeking surgical aid or delay on the part of the physician consulted in recommending a radical operation.

Any ulcer of the lip which persists for a few weeks should be regarded as highly suspicious of cancer. If such ulcers are surrounded by a slightly indurated area, the great majority prove to be epitheliomas. They occur most often in males above thirty-five years of age, but the condition is frequently seen in younger persons, so the age cannot be regarded as an important factor. Practically the only other condition to be taken into consideration in the diagnosis is syphilis, a condition in which lesions on

* Read before the Oswego County Medical Society, Oswego, New York, October, 1920.

the lip are seldom seen. In cases in which doubt exists as to the true nature of the condition, it is best to excise the growth by a V incision for diagnostic purposes. Very little deformity results from such a procedure and, if the condition is found to be malignant, good results may be expected to follow a radical removal of the glands at this time or shortly afterward.

The lymphatic drainage from the lower lip passes through the submental and submaxillary groups of lymphatics. The submental lymphatics lie in the triangle bounded by the anterior bellies of the digastric muscle and of the hyoid bone and drain the central portion of the lower lip. The submaxillary lymphatics lie in the submaxillary triangles, each of which is bounded by the digastric muscle and the ramus of the lower jaw; these lymphatics drain the remainder of the lower lip as well as the anterior portion of the cheek. Under ordinary conditions the outer portion of the lower lip on each side is drained by the submaxillary lymphatics on that side. The lymphatic anastomosis in this region is free and in case of any blocking of the lymphatics on either side by inflammation or cancer, the lymph may drain through the lymphatics on the opposite side. For these reasons it is necessary in treating cancer of the lip to remove the submaxillary lymphatics on each side. We have frequently seen involved glands on the side of the neck opposite the growth while no glandular involvement could be demonstrated on the side with the growth.

In small growths, when the diseased tissue can be removed by the ordinary V incision, it is best to excise the glands first and immediately after the incision has been closed and while the patient is still under an anæsthetic, to remove the growth from the lip. If, however, the growth is extensive and it is necessary to remove a large portion of the lip, it is usually better to perform the operation in two stages. In such cases, if the glands are excised first the growth may be removed after three or four days under a local anæsthetic or, if preferred, the growth may be removed first. The only objection to the latter method is that occasionally considerable infection follows the removal of the growth and this makes it necessary to delay removing the glands.

If possible the glands which are removed should be examined immediately. If laboratory facilities do not permit this the tissues removed from each side should be kept separate and carefully labelled in order to show definitely later which side is involved in case the tissues removed are found to be malignant.

The technic employed in removing the submaxillary and submental glands as a prophylactic measure in the ordinary patient with cancer of the lip is as follows:

An incision is made parallel with the body of the lower jaw about midway between the upper portion of the thyroid cartilage and the symphysis of the jaw, and extending from the inner border of the sternomastoid on one side to a similar point on the opposite side. The skin

and platysma muscle are reflected upwards as high as the jaw-bone and all of the glands and fascia lying between the anterior bellies of the digastric muscles (the submental group) are excised. The glands, fascia, and fat, including the submaxillary salivary gland, are then removed from each submaxillary triangle. The lower jaw limits the dissection above and the pulley and posterior belly of the digastric muscle are used as landmarks to limit the dissection below. Both submaxillary salivary glands are removed because they are surrounded by small lymphatics. The ducts of the submaxillary salivary glands are cut off just underneath the mylohyoid muscle, and the facial arteries and veins are cut off at the level of the digastric muscle and again at the point where they cross the lower jaw-bone.

It is necessary to guard against injury, first, to the lingual branch of the fifth nerve which runs underneath the mylohyoid muscle at a point just above the salivary duct; second, to the hypoglossal nerve which passes underneath the digastric muscle near its pulley and then runs underneath the mylohyoid muscle just below the salivary duct, and third, to the inframandibular branch of the seventh nerve which crosses over the facial vessels at a point about 1.5 cm. below the jaw-bone. All of these nerves are important and should be avoided. The lingual branch of the fifth nerve on each side supplies sensation to one-half of the tongue; each hypoglossal nerve supplies motion to one-half of the tongue, and the inframandibular branch of the seventh nerve on each side supplies motion to its one-half of the lower lip and angle of the mouth. The hypoglossus muscle forms the bottom of the submaxillary triangle; all the fat down to this muscle is removed.

If the glands on either side are found to be involved at the time of operation all the glands draining that side of the neck should be removed by what is ordinarily known as block dissection. In such cases the primary incision is extended outward on the side where the involvement is found across the sternomastoid muscle, and a second incision is made at right angles to the first, beginning at the inner border of the sternomastoid above, and extending downward to a point near the juncture of the inner and middle thirds of the clavicle. The glands and fascia from all the triangles on that side of the neck are then removed up to a point as high as the styloid process; the dissection extends down to the deep muscles of the neck, the glands and fascia lying along the carotid artery and the internal jugular vein being removed. Care must be taken to avoid the phrenic nerve, the brachial plexus, the common and internal carotid arteries and the hypoglossal, pneumogastric and sympathetic nerves. The sensory branches of the cervical nerves are cut near the point where they emerge from the muscles. The omohyoid and sternomastoid muscles are removed and the spinal accessory nerve is sacrificed. Of course, the sacrifice of this nerve is followed, in the majority of cases, by paralysis of the trapezius muscle. It is possible to preserve the

sternomastoid muscle and the spinal accessory nerve, but this requires more time and the operation probably is not so thorough, so, because of the seriousness of the condition which is being dealt with, it seems permissible to sacrifice these structures. If the internal jugular vein is involved it may be sacrificed on one side of the neck without fear of a bad result. Injury to the common carotid or the internal carotid arteries, necessitating the ligation of either of these vessels, especially in patients more than forty, will be followed by an extremely high mortality. If necessary, the external carotid may be ligated on one or both sides. An operation of this type, although long, is associated with a very low operative mortality.

In reviewing the histories of the patients operated on in the Mayo Clinic during the years 1912, 1913, and 1914, only the patients who had primary operations in the Clinic were considered, in order that we might more clearly ascertain the possibilities of the operation in primary cases. In many of these patients, however, the growth had been removed or partially destroyed on one or more occasions by the use of pastes or caustics. After dropping from the series the cases of recurrence, 178 remained. In two of these an incomplete operation was performed; that is, an operation in which it was impossible to remove all the diseased tissue; these two cases were, therefore, discarded from the list studied. We were unable to obtain data after operation in thirty-four cases; these were also dropped from the list, leaving 136 cases which form the basis of the study.

In attempting to obtain a true report of the results obtained following operations performed a number of years before, it is often difficult to know just what cases should be discarded from the list to be studied. Nothing can be learned of the end-results secured from a study of the histories of patients concerning whom no data can be obtained after operation. Previous studies of histories in a large series of patients operated on years before have proved conclusively that the majority of patients from whom no data can be secured are alive. The longer one attempts to obtain information regarding such patients the higher, as a rule, is the percentage of cures obtained. It is usually easy to hear that patients are dead; those who are living a considerable period after operation have often changed addresses several times and letters to them are returned unclaimed.

The 136 cases were studied in three groups:

Group 1 comprises ninety-eight cases in which a primary complete operation was performed when the glands were not involved; that is, a local excision of the growth with removal of the glands draining the lower lip. Fourteen of these patients are dead; five had died from disease other than the cancer and without a recurrence of the malignancy. Three letters were returned marked "deceased" without further data regarding the cause of death or as to whether a recurrence had occurred.

Six patients had apparently died of a recurrence of the disease. If the five patients who died of other causes are excluded, ninety-three patients remain on whom primary complete operations were performed, with nine deaths, six of these deaths from known recurrences; consequently, 90.3 per cent. of the patients are alive from five to eight years after operation. In eleven of these local recurrences occurred and in three recurrences occurred in the glands, which were subsequently removed; two of these probably have a recurrence at the present time.

Group 2 comprises eleven cases in which the glands were involved at the time of operation. In six cases a block dissection was done in addition to removal of the submaxillary and submental lymphatics. Five of these patients are dead and one is alive, five years and three months after operation. In the five other cases of this group, on account of the age or physical state of the patient block dissections were not done; the involved groups of glands only were removed. Four of these patients are dead and one is alive five years and eight months after operation. Of the eleven patients, then, who had glandular involvement, only two (18.1 per cent.) are alive five to eight years after operation. In this group it is known that one local recurrence and three recurrences in the neck occurred. This percentage of cures is much lower than that previously reported from the Clinic, but the duration of time since the operation is considerably longer in the group of patients studied in this paper than that in the groups on which the former statistics are based.

Group 3 comprises twenty-seven cases in which the growth only was excised, usually on account of the age or physical condition of the patient. Nineteen of the patients are alive from five to eight years following operation. Three of those who died are supposed to have died of disease other than cancer of the lip and without a recurrence of the malignancy. If these patients are deducted from the group, twenty-four remain, with five deaths; that is, 79.2 per cent. of from five- to eight-year cures. Seven of the patients who are alive had recurrences of the growth which were subsequently removed; one of these probably has a recurrence at the present time. Two of the patients who died had local recurrences and three had recurrences in the submaxillary glands.

A review of these cases shows that the percentage of cures following operation in cases in which the glands are involved are much lower than in cases in which operation was performed before the glands became involved. The percentage of from five- to eight-year cures when the glands were involved is almost identical with that obtained in cases of cancer of the breast when the glands are involved. The percentage of local recurrences seems too large. This probably could be avoided to a certain extent by a wider removal of the growth and the use of radium after operation. Rapidly growing epitheliomas, and especially those growths with a marked inflammatory reaction surrounding them, are best removed with the actual cautery without attempting to perform a plastic opera-

tion at the time. In cases in which the glands have liquefied, broken down and extensively involved the surrounding tissues no relief can be expected. Such cases are probably best treated by means of radium and X-ray.

Treatment of the growth by means of radium and the X-ray without removal of the glands does not seem a radical procedure. We have seen a number of patients with an extension of the malignancy later into the glands while the primary lesion remained cured. There is no doubt that radium often destroys the growth, but such a procedure is almost identical with the methods in which the growth is removed with pastes or by local excisions. We know from experience that although there may be no local recurrence of the growth following the latter procedures, in about from 20 per cent. to 30 per cent. of the cases, metastasis occurs later in the submaxillary and submental glands.

SALIVARY CALCULUS IN AN ACROMEGALIC

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THE following example of a rather infrequent pathological condition offered an interesting problem for differential diagnosis.

SURG. No. 11558.—Mrs. C. G., aged fifty-six years, was admitted November 26, 1919, complaining of a tumor under the right jaw.

The patient, an acromegalic of marked degree, had first noticed two or three years before entrance a hard, painless swelling beneath the angle of the right jaw, the size of a small grape. This caused no symptoms and showed no apparent increase in size until two months ago. At that time, without known cause, this swelling increased suddenly in size, becoming very tender and painful. In about twelve hours it became the size of a small egg, the cheek, floor of the mouth and right side of the tongue all being swollen. There was marked dysphagia and speech was practically impossible on account of the intense pain accompanying any movement of the jaw or throat. The patient was unable to sleep at night. In addition to the severe local pain there were spasmodic attacks of darting pain in the supra-orbital, auricular and maxillary regions.

This condition persisted for about two weeks without relief, and without the patient being able to tolerate anything by mouth except occasional sips of fluid. Hot poultices were applied externally to the tumor with slight relief. Gradually the swelling subsided to about the size of a walnut and the acute symptoms disappeared except for occasional twinges of pain along the mandibular division of the trigeminal nerve. A diagnosis of osteoma of the jaw had been made two weeks before admission, based upon an X-ray examination.

Examination.—The patient showed the physical characteristics of chronic acromegaly, but with no pressure symptoms from the glandular enlargement. The swelling below the angle of the jaw was, therefore, the only consideration so far as treatment or diagnosis was concerned. This was a hard mass about the size of a walnut just below the angle of the right lower jaw, to which it was apparently attached, and though there was possibly some slight mobility, the mass suggested a skeletal exostosis associated with her acromegaly.

A second X-ray examination, however, revealed an opaque, probably calcified body, not connected with the jaw, the shadow measuring 24 mm. by 32 mm. (Fig. 1).

Operation.—Under a local anæsthetic, by an external incision, the entire lesion was found to be limited to the submaxillary gland,

which was removed. The surrounding tissues were indurated and somewhat thickened. The patient recovered without any complications.

Pathological examination showed an indurated submaxillary gland, containing an irregular, yellow mass of calcareous substance, filling a cavity in the gland lined with a definite membrane. The cavity communicated directly with Wharton's duct, and the calculus could be readily felt by a probe passed down the lumen of the duct. It was roughly olivary in shape, one end tapering to a point as it entered the duct (Fig. 2). Its weight was 9.4 gm. By microscopical examination the surrounding tissues showed a chronic inflammatory process, with increase in fibrous tissue. The above calculus was much larger than the majority of those reported in the literature.

A correct diagnosis should be made prior to operation by combining the physical findings, the history of sudden swelling and pain, dysphagia, and the shadow shown by the X-ray. Failure to make such a diagnosis may be attributed to the fact that a salivary calculus was not considered, and further that a careful bidigital examination was not made of the mass, nor was Wharton's duct explored with a probe.

Examination of the literature shows that salivary calculi, while uncommon, occur with sufficient frequency to render their diagnosis important and not extremely difficult. An analysis of numerous articles reveals a characteristic set of symptoms. Sudden onset of pain in the floor of the mouth, over the submaxillary region, or that of the other salivary glands, associated with swelling and exquisite tenderness, all increased by food and mastication, are the primary symptoms. A mass may or may not have been noticed prior to the attack. In the above case the mass was known to have existed in the submaxillary region for about three years without symptoms. Several cases have been reported where there was a known hard tumor in the submaxillary region present for over ten years. In one of Alexander's cases such a tumor had been present between thirteen and fourteen years. On the other hand, the calculus may have existed for years without being discovered, the only knowledge of abnormality presenting itself with the initial attack of acute symptoms, entirely analogous to the so-called "silent" renal or biliary stones.

Examination generally shows a distinct swelling in the region of one of the salivary glands, best demonstrated by bidigital examination, the swelling being hard, slightly movable, and very tender in acute cases. If the stone be in the submaxillary gland it is frequently possible to palpate it by means of a probe passed into the lumen of the duct, and not infrequently pus may be extruded from the duct orifice by gentle pressure on the gland. X-ray will confirm the findings by showing a distinct shadow in the region of the tumor. In severe cases the floor of the mouth is very swollen and tender, as may be the cheek and tongue on the same



FIG. 1.—Calculus in submaxillary gland.



FIG. 2.—Calculus embedded in submaxillary gland.

side. Talking and swallowing are extremely painful, and may be impossible—indeed, the swelling may be so great as to prevent examination by mouth. Abscess of the affected gland may be present, with necrosis and even fistula formation. Usually the patient will give a history of intermittent attacks of painful swelling in the regions of the affected gland, of sudden onset, increased by food, and generally of short duration and rather sudden regression.

Cases have frequently been diagnosed as carious teeth with root abscesses to be contradicted by X-ray. Many have been diagnosed carcinoma or osteoma, the calculus being discovered only at operation.

Salivary calculi are formed from the inorganic salts in solution in the normal saliva. Under abnormal conditions these are deposited, usually on the teeth as tartar, occasionally in the salivary ducts or acini as calculi. The calculi may have as nuclei bacteria, epithelial débris or a foreign body. The inorganic salts concerned are the carbonates and phosphates of lime, potash and magnesium. Bacterial action or actual lodgement of a foreign body sets up an inflammatory process around the orifice of a duct or acinus, which causes blocking, constricting or roughening, and the decomposition of the saliva, with consequent deposition of salts. Calculus formation gradually results, the final stage being a stone which may later be rejected if not of large size. On the other hand, it may be retained in the gland or duct, obstructing the flow of saliva and causing the symptoms which had been mentioned. Occasionally, however, there occurs no obstruction or symptoms therefrom.

Salivary calculi are most often found in Wharton's duct, but may be found in the gland itself or in either of the other salivary glands or their ducts. In the Breslau clinic, Czygen reports thirty-seven cases, occurring as follows: Wharton's duct, 22; submaxillary gland, 4; Stenson's duct, 5; parotid gland, 1; sublingual duct, 4; Bartholini's duct, 1; total, 37. Bevan's report of twenty cases seen at the Presbyterian Hospital, Chicago, gives a similar occurrence. Keen states that the calculi occur in the submaxillary gland and ducts five times more often than elsewhere. Other observers do not give so high a percentage as this, but all agree that the stones more often occur in or near Wharton's duct.

The majority of cases occur in males around middle life, few being found in children, although one case is reported of a salivary calculus in an infant of three weeks.

Calculi vary in size from that of a BB shot to that of a large walnut. Those smaller than a bean are usually ejected spontaneously without symptoms. They are usually yellow in color, irregular in shape, and if large and located in a gland, taper at one end to conform to the entrance into the gland of its duct. They are usually single, but multiple calculi have been reported.

Complications if untreated may be serious. Abscess formation is the most common. Fistula may result, and necrosis of the jaw following a

large abscess may occur. Ranula has been reported following obstruction of a duct, although the usual obstruction is not a permanent thing.

Treatment is always surgical, removal of the calculus and, if necessary, of the affected gland. In the case of small stones an incision in the buccal mucosa over the aperture of the duct will frequently be sufficient. Where the gland is involved, and there is inflammation and induration, radical removal is best, and an external incision and dissection is necessary. In the cases where the parotid is involved this may be extremely difficult, owing to its close relation to numerous important anatomical structures which may be involved in the process. Healing of the wound following operation generally occurs without the formation of fistula or other complications. Recurrences of stones have been reported, but are rare.

Salivary calculi, though not common, occur with sufficient frequency to warrant careful consideration. They should always be included in a differential diagnosis of tumor involving the floor of the mouth, lower jaw, or the parotid. Clinical symptoms and findings are ordinarily sufficiently characteristic to determine the diagnosis. If not, röntgenogram examination will decide the nature of the tumor and its exact location, and occasionally will pick up cases that were previously unsuspected. Selby's report of nine cases of salivary calculi that were discovered after being referred as root abscesses is enlightening. In all but one of his cases calculus was not even considered, but the diagnosis was made by careful stereoplates, which he believes essential to accurate demonstration. Complications of sialolithiasis may be very serious, and surgical treatment is always indicated where any abnormal symptoms exist.

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THE TREATMENT OF ACUTE SUPPURATIVE PLEURISY

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WITHIN recent years a great impetus has been given to the study of suppurative pleurisy by the epidemic of pulmonary diseases, especially influenza, which swept over the world and by the larger number of chest wounds with their coincident infection which occurred during the World War.

The resulting studies of the condition have given evidence that there was and still is much to be learned regarding this condition, and that there is a definite need for a better understanding of the methods of treatment applicable to the various types of the disease.

Given a case of suppurative pleurisy established by the orthodox methods of diagnosis (physical signs, aspiration of chest, X-ray examination), what must our treatment be? First, to save the life of the patient. Second, to leave the patient with a symmetrical chest and fully expanded lungs, and third, to shorten the time of the patient's convalescence.

The types of suppurative pleurisy ordinarily given are diffuse, encapsulated, sacculated, intralobar, etc. While the above are terms of relative value, it would seem that the type of the infecting organism plus the nature or source of the original disease would be of more value and lead to a better understanding of the factors concerned in the treatment of the disease. For that reason it would be better to classify the various types of suppurative pleurisy, for example, as:

Suppurative pleurisy—pneumococcus—second to pneumonia.

Suppurative pleurisy—streptococcus—second to influenza, etc.

The reason for so doing can be definitely explained by the difference easily noted in the two above forms.

The suppurative pleurisy due to the pneumococcus is usually secondary to a lobar pneumonia, the patient is usually past the extremely critical stage of the disease and the exudate is definitely purulent when recognized; that is, the condition is a sequel or complication of the original disease. Treatment in this variety can be directed toward the removal of the purulent exudate and is chiefly concerned with the restoration of chest function in the shortest time possible.

In the suppurative pleurisy, due to the streptococcus, the exudate usually occurs very early in the disease and is, as a rule, not purulent at first. The patient is in the most critical stage of the disease with marked cyanosis, dyspnoea and prostration as a result of the severe infection and

not as a result of the pleuritis. That is, in this variety the pleurisy is a part of the disease, occurs early and does not become frankly purulent until an interval of at least two or three weeks has elapsed. (See report of the Empyema Commission, *Journal American Medical Association*, vol. lxxi, 1918.)

Failure to recognize the above differences in type cannot do otherwise than produce undesirable results, and early operations done as soon as the diagnosis of suppurative pleurisy was recognized in the streptococcus cases produced a very high mortality.

It had also seemed to the writers that the older classifications of the suppurative pleurisies could not be considered of value from the standpoint of the treatment of the varying types. That is, it was the writers' impression that the variety of suppurative pleurisy which followed lobar pneumonia, and in which the pneumococcus was the cause of the suppurative pleurisy, seemingly recovered rapidly and satisfactorily when sufficient drainage was inducted and maintained, and that the mortality was more or less dependent upon an early recognition of the presence of pus in the pleura and its prompt removal.

Contrariwise, there was another variety of suppurative pleurisies due to a varying group of organisms in which it was not so simple a matter to outline a method of surgical treatment which gave the satisfactory outcome experienced in the first group, and that more extensive operations and more frequent secondary operations were required to effect a cure.

As has been stated, the streptococcus pleurisies in influenza did not and could not do well by early operations done during the critical period of the disease. Furthermore, the pleural infection was the result of small or larger lung abscesses which ruptured into the pleural cavity and produced a more complicated pathological process than that in the first group. (See Hartwell.¹)

Hence the methods applicable to the first group must be modified to suit the individual requirements of the various varieties of this second group as they occurred.

These factors have been fully substantiated by the experience of the Empyema Commission during the war, and by the recent contributions of Lilienthal, Eggers, Moschowitz, Hartwell, Hedbloom, Homans, Tuffier and others. Many of these factors will be discussed later when the analyses of the cases upon which this report is based are examined.

Since the advent of the X-ray and its more careful and complete application to and the more skilful interpretation of the plates of the various types of suppurative pleurisy there has been a decided improvement in the results obtained.

The result of aspiration of the chest cavity can thus be followed and residual exudates removed by operation, or when operation has been done the progress of the case, *i.e.*, the expansion of the lung and the closure of

¹ Abscess of Lung: ANNALS OF SURGERY, 1920, vol. lxxii, p. 333.

the purulent cavity or the factors which are causing delay, can be more definitely determined.

Furthermore, it has also seemed to the writers that the more extensive exploration of the chest cavity, such as that popularized by Delorme, Fowler, and Lilienthal, has rapidly tended to replace the older chest-deforming operations of Estlander and Schede, a marked advance in the writers' opinion.

Experience with these operations and the more formidable operations of lobectomy for the pulmonary lesions which complicate the disease will rapidly approach the satisfactory surgical position now occupied by other major surgical procedures which not long since were considered entirely too radical.

The experience of any one individual is unlikely to cover all the manifold manifestations of this condition, hence certain varying opinions of the utility of this or that procedure are bound to exist, but time, experience and the careful analysis of groups of cases will for suppurative pleurisies develop a group of surgical methods similar in its efficiency to those developed for other major surgical procedures.

The attempt to sterilize the chest cavity by irrigations with various antiseptics is not new, but the recent introduction of the Dakin solution by the method of Carrel has again brought this method to the fore.

Here again opinions vary as to its efficacy, and it is the writers' impression that the character of the infecting organism, the character and efficiency of the drainage, and other complicating pleural and pulmonary conditions will have more effect upon the outcome of the case, the time and character of the healing, and the eventual result than will the effect of sterilization of the chest cavity by this or any other method of sterilization.

To get the proper perspective upon this subject means a careful examination of the results of those who use the method properly, compared to those who do not use it or parallel series in the hands of the same observer. Just at present there seems to be too much taken for granted on both sides of this question.

When drainage of the chest is contemplated certain factors must be considered, and it is difficult to speak with authority concerning that which is the most serviceable.

The situation which seemingly has been most serviceable for drainage has been the region of the eighth rib in the posterior axillary line.

In drainage of the chest the relation of the size of the drainage tube opening to the opening into the trachea (cross-section of drainage tube to the cross-section of the opening into the glottis) must be considered.

A tube sufficiently large to allow for drainage is essential, but the tube should not be as large as the glottic opening. If the tube is as large as or larger than the glottic opening, collapse of the lung is inevitable, and unless the mediastinum is fixed by the inflammatory process the opposite

lung will be hindered in its proper expansion and respiration will be seriously hampered. (This factor probably explains the seriousness of the open chest wounds encountered during the war and the success following the closure of these wounds.)

Furthermore, gravity alone cannot entirely drain a chest cavity. To effect drainage the pumping effect of the expanding lung and the movements of the diaphragm upon the fluid in the chest are important factors.

In so far as the writers know, no definite plan exists for measuring this relationship between the size of the glottic opening and the size of the drainage tube. A method of estimating the size of the tube to be used practiced by the writers has been of practical benefit. The size of the glottic opening is estimated by placing the thumb and first finger on the cricoid cartilage, thus obtaining roughly the diameter of the larynx. A drainage tube three-fourths the size of the diameter thus obtained gives a tube which is smaller than the glottic opening, yet large enough to produce thorough drainage.

Through such a tube the exudate drains out of the chest cavity with each inspiration, and the lung is at least partially expanded. If the drainage tube is open at its external end, air naturally enters the cavity during expiration, so that there is a constant variation in the quantity of fluid, air and expanded lung in the pleural cavity.

If the lung has retained its elasticity or is not fixed by adhesions, a constant gradual expansion of the lung occurs and this, with the upward movement of the diaphragm, tends to obliterate the cavity and to effect a cure.

Numerous methods to aid in producing this expansion or maintaining the expansion once produced have been proposed.

In brief the methods are:

1. Those which increase intratracheal tension.
2. Those which decrease the tension in the pleural cavity.
3. Those which maintain the lung expansion by preventing the entrance of air into the pleural cavity after establishing the drainage.

All are of benefit in properly selected cases and can be used in various combinations.

Of the methods used to increase intratracheal tension the Wolff bottles popularized in this country by Walter James have been the most serviceable and properly used are quite valuable. In our children's wards the small inflatable rubber balloons have proven of educational value in teaching the children to blow into the bottles later.

Various devices for producing suction in the pleural cavity have been proposed. At the New York Hospital the device for maintaining suction proposed by Kenyon and Connell (the principle of the Sprengel pump) was utilized for this purpose but did not prove efficacious, and in a number of cases had to be abandoned because of the hemorrhage produced—

that is, the exudate under this method became blood stained and occasionally frankly bloody, while the lung expansion was not apparently increased.

The methods for obtaining drainage and at the same time preventing the entrance of air into the pleural cavity are many and ingenious. In general they may be separated into two groups:

First, some form of drainage tube with a valve which allows for the escape of the exudate with expiration and which closes with each inspiratory effort, and second, the gravity siphonage drainage method devised by Kenyon.²

This latter method has been the one used by the writer and has been most serviceable. A tube sufficiently large is selected and over this a cuff of larger tubing is placed so that it occupies the position on the drainage tube where that tube emerges from the wound. A piece of rubber dam about four inches square is then perforated at its centre and drawn over the tube—so that it hugs the drainage tube on the chest side of the rubber cuff above described. A bottle containing water, a connecting piece of glass or metal, and a long piece of rubber tubing are also prepared. At the operation the drainage tube is placed in the chest and connected with the long piece of tubing and the end of this latter tubing placed under the water in the bottle. The flange of rubber dam is fastened to the skin about the wound either by the rubber cement used in mending rubber gloves or by adhesive plaster, and this furnishes an airtight opening into the pleural cavity. With each inspiration the air which has entered the cavity during the operation is then forced out and then the fluid follows. The method has been found applicable for drainage in a simple thoracotomy, thoracotomy with rib resection, or in the more radical type of operation suggested by Lilienthal.

Drainage by this means can be maintained for from four to nine days, after which time leakage about the tube and wound irritations require its removal and open drainage is then necessary.

The reaction following the operation is markedly decreased by this method of drainage. In the seriously sick cases thoracotomy with drainage by this method may be done rapidly and with very little reaction, and a secondary operation may be undertaken later, if the above is not sufficient, with very much less danger to the patient.

To determine what had been the result obtained by the routine treatment of acute suppurative pleurisy in a civil hospital service, the records of the First Division at the New York Hospital were studied and an analysis of the cases is made in this paper.

No attempt has been made to include the chronic empyemas, and where mention is made of the chronic cases and their treatment, it is done to show the result of the preceding acute case rather than to discuss the chronic condition.

² Kenyon: *Operative Therapeutics*. Johnson, Appleton Co., 1915, vol. i, pp. 229-247.

The result has been taken from the follow-up system in use on the First Surgical Division described by Gibson.³

The records of the First Division (Cornell Division) of the New York Hospital from January 1, 1914, to January 1, 1920, show that 134 cases of suppurative pleurisy have been observed on that division. (This constitutes one-half of the entire hospital service.) Of the 134 cases, 111 were operated upon with nineteen deaths, a mortality in the operated cases of 17.1 per cent. Twenty-three cases were not operated for various reasons, such as refusal of permission to operate, patients moribund on admission, condition not recognized, or aspiration was sufficient to effect a cure. In this group are also included some cases in which the diagnosis of suppurative pleurisy is somewhat doubtful. Of these twenty-three cases ten died—a total mortality for the series (twenty-nine in 134 cases) of 21.6 per cent.

For the purposes of this paper the mortality to be considered is that after operation, or 17.1 per cent. Many of the cases in this list were in extremis upon admission, but no case was refused operation in which the diagnosis of suppurative pleurisy could be made and in which sufficient time was given to do the operation. Four cases died on the day of operation and all were critically sick at the time the operation was undertaken. This statement is made with no desire to juggle statistics, but merely to show that there was no selection of cases made to obtain favorable mortality statistics, and that the mortality of 17.1 per cent. represents that of the ordinary run of cases in a civil hospital service.

The essential principle followed throughout was to secure satisfactory drainage, and the site almost universally chosen was the eighth rib in the posterior axillary line. Two chief types of operation were used—thoracotomy in the eighth interspace or thoracotomy with the resection of the eighth rib.

TABLE I

Of the 111 cases submitted to operation:

19 Cases died	17.1 per cent.
64 Cases were cured	57.66 per cent.
9 Cases improved	8.1 per cent.
5 Cases unimproved	4.5 per cent.
14 Cases could not be followed	12.6 per cent.

111

TABLE II

Cases surviving the operation:

64 Cases were cured	79.5 per cent.
9 Cases were improved	9.78 per cent.
5 Cases were unimproved	5.4 per cent.
14 Cases could not be followed	15.2 per cent.

To determine any difference which might exist in the results obtained by thoracotomy or by thoracotomy with rib resection the two are analyzed separately in the following tables:

³ Gibson: ANNALS OF SURGERY, December, 1919.

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INTERCOSTAL THORACOTOMY

6 Cases died	13.63 per cent.
27 Cases cured	61.3 per cent.
2 Cases improved	
3 Cases unimproved	
6 Cases not followed	

—
44

THORACOTOMY WITH RIB RESECTION

13 Cases died	19.4 per cent.
37 Cases cured	55.2 per cent.
7 Cases improved	
2 Cases unimproved	
8 Cases not followed	

—
67

From the above tables it would therefore seem that thoracotomy with sufficient drainage has given a lower mortality with a higher percentage of cures, but the difference is not sufficient to establish the value of that procedure over thoracotomy with rib resection.

There was also no very marked difference in the length of the stay of the patients in the hospital, and the per cent. of cases submitted to secondary operation was practically identical for each type, so that for this series it is not possible to differentiate between the two types of procedure.

The writers prefer thoracotomy with the Kenyon type of drainage for the average case, but in this series in which the operations were done by four men the preference evidently was for thoracotomy with rib resection.

The cases submitted to operation are analyzed in the "Anæsthesia Chart" with reference to the character of the anæsthesia used.

Under the headings "No anæsthesia" and "Local anæsthesia" are included those cases so seriously ill that an anæsthetic was of secondary consideration and naturally a higher mortality is to be expected.

In all cases a preliminary hypodermic injection of morphine and atropine was given except in the very young children.

The anæsthetic selected must necessarily be one applied to the given case and be chosen to fit the operation contemplated. When a rapid drainage operation is contemplated some form of local anæsthesia will suffice. When a more extensive operation is contemplated ether alone or in combination with nitrous oxide and oxygen has given the most satisfactory results.

In our series there were thirty-two cases of suppurative pleurisy due to the pneumococcus—twenty-seven followed lobar pneumonia, two pneumonia complicating measles and three influenzal pneumonias. Of these, three cases died, a mortality of 9.3 per cent.

The fatal cases were one year, eighteen months, and two years, nine months old. One case was moribund on admission and died soon after

the operation. The other two died of malnutrition. In the older child the first operation failed to drain properly and a second operation was done, and in this case the insufficient drainage probably was a contributing factor to the fatal outcome.

ANÆSTHESIA CHART

Type of Anæsthesia	Number of Cases	Deaths	Per cent. Mortality
No anæsthesia.....	5	2	40 per cent.
Anæsthesia not mentioned.....	1	1	100 per cent.
Local anæsthesia infiltration.....	14	3	21.4 per cent.
Ethyl chloride.....	7	1	14.2 per cent.
Ether.....	62	9	14.5 per cent.
Ether combination.....	14	2	14.2 per cent.
Nitrous oxide.....	4	0	0
Gas oxygen.....	4	1	25 per cent.
	111	19	17 per cent.

Of the twenty-nine cases which recovered, four cases could not be traced after their discharge. One of these cases was removed from the hospital while still quite sick, against advice, and three were discharged cured with small superficial sinuses which still required dressings.

Of the twenty-five cases followed, twenty were excellent results with normal chest expansion. Four cases had some limitation of expansion on the affected side and in one case the result is stated as an excellent result, but no mention is made of the chest condition. Seven of the above cases were submitted to secondary operation, four for insufficient drainage, two for necrosis of the rib, and one for an acute suppurative myositis about the drainage wound.

Intercurrent diseases occurred in seven cases, measles in one, otitis media in three, abscess of the buttock in one, chicken-pox in one, phlebitis in one. Three of the cases had chronic valvular heart disease and one was a chronic alcoholic previous to the present disease.

From this analysis it can be seen that the mortality for this series was confined to the young infants, that a satisfactory result as regards chest expansion was obtained in 80 per cent. of the cases, and that some slight deformity of the chest (limited expansion) occurred in 16 per cent.

Thoracotomy with rib resection was the operation of choice. Two cases died when this was used and one when thoracotomy alone was practiced. The differences between the two operations are not sufficient to give any preference to one or the other.

Dakin's Solution was used by the Carrel method in four cases and no appreciable difference in the time of cure or in the result obtained could be noticed.

Kenyon drainage was used for three cases. There was no appreciable difference either in the result of the drainage as to the final result, time of discharge, or in the condition of the patient after the operation. This

was rather interesting to one of us (Hitzrot) as a result of this study, as the impression in that observer's mind was that there was a distinct benefit to be obtained by this method applied to all types of chest drainage.

The chief aim of the operation for this type of infection for this series must then be said to be, to obtain and maintain sufficient drainage, and when this was done the various modifications and additions to the treatment seemed in no way to affect the result.

There were twenty-two cases of suppurative pleurisy from which the streptococcus was isolated.

The bacteriological report simply states streptococcus in seven, streptococcus viridans in five, streptococcus hæmolyticus in ten.

The preceding condition is stated to have been pneumonia in ten of these cases, influenza-pneumonia in four, broncho-pneumonia in two, tuberculous broncho-pneumonia in one, measles-pneumonia in two, pneumonia after tonsillectomy in one, pleurisy in one, infarct of lung following appendectomy for acute appendicitis in one.

In the three fatal cases the suppurative pleurisy was a complication of a preceding disease in two cases, in one tuberculous broncho-pneumonia, in the other acute appendicitis with abscess formation and infarct of the lung on the tenth post-operative day.

Of the nineteen cases which recovered two could not be followed long enough to determine the final result. One was discharged on the thirty-first day after operation in excellent condition, in the other at the three months interval there was a small superficial sinus which was still discharging, and the patient disappeared.

Of the seventeen cases followed twelve were excellent results with normal chest expansion. In four cases there was distinct limitation of expansion with thickened pleura. In one case (the patient with tuberculous pleurisy) the patient is still under treatment at another hospital with a discharging sinus and the condition is reported as unsatisfactory.

Five of the above cases were submitted to secondary operations before a cure was obtained. (One was the failure classed as unsatisfactory result (v. supra), and the specimen removed from the pleura in this case showed numerous tubercles.) In one case revision was done twice because of insufficient drainage with closure of the sinus, and the condition was stated as excellent at the five-months interval. In one case drainage was insufficient, due to adhesion of the lung about the abscess tract, and healing was obtained only after decortication and mobilization of the lung with excision of the sinus which ran to what evidently had been an abscess of the lung with a localized pleurisy partially walled off and which later ruptured and produced a general pleural infection.

In two cases, both with abscesses of the lung, a number of operations were necessary to effect a cure, and in one case included a lobectomy for bronchiectasis followed by a bronchial fistula for eighteen months, which eventually closed and the patient has remained well at the four-year

interval. One was a partial lobectomy for the excision of a thick-walled abscess on the posterior surface of the periphery of the lower lobe with mobilization of the lung and excision of the old drainage tract.

The intercurrent conditions were abscess of the submaxillary region one, otitis media one, acute rheumatic fever one.

Two cases had a fairly definite pulmonary tuberculosis which antedated the suppurative pleurisy.

The low mortality in this series, especially in the influenza cases, is undoubtedly due to the fact that aspiration was so consistently practiced by the medical staff before the transfer of the patients to the surgical side and also to the fact that the critically sick patients during the epidemic of influenza did not reach the hospital. Such cases as did come to the surgical side were, therefore, selected cases in the sense that they had survived the original condition and were better surgical risks than the cases reported from the army hospitals. (See report Empyema Commission.)

Thoracotomy with rib resection and open drainage was again the operation most resorted to. The reaction from the operation apparently was somewhat less in those cases in which thoracotomy with Kenyon siphonage drainage was used. One of the cases was submitted to the operation described by Lilienthal and for that particular case the operation proved most efficacious, and a simple drainage operation would not have been suitable. (The decision to use that type of operation was based upon the X-ray examination and showed a localized process communicating by a narrow tract with the general cavity.)

Dakin-Carrel irrigation was used in five of the cases without any appreciable result except that of deodorizing the secretion in two of the cases.

The one fact that stood out in the cases of streptococcus pleurisies in this series was that the process was a more complicated one than that due to the pneumococcus, and that the result of the surgical treatment as well as the choice of the operation depended upon the underlying lung involvement. Where this was slight the cases recovered in about the same time as the pneumococcus cases and the essential feature was sufficient drainage, and the various modifications had no very practical significance.

When the underlying lung or pleural condition was tuberculous the result was unsatisfactory, as are many of the surgical forms of tuberculosis. In the cases with more extensive lung involvement (lung abscess plus extension into the pleura or into the bronchi) the drainage of the pleural process had to be supplemented by further operation to effect a cure.

The organism in twelve cases was reported as staphylococcus in one, staphylococcus albus in five, staphylococcus aureus six.

The preceding condition is stated to have been pneumonia in five cases, measles-pneumonia in one case, broncho-pneumonia in one, influenza-pneumonia in four cases, and not stated in one case.

Two cases died (one of the pneumonias, and the broncho-pneumonia).

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Of the ten cases which recovered two could not be traced after their discharge. (One improved, one cured, at the time of discharge.)

Three cases are reported as excellent at varying periods after the three-months interval.

Two cases were reported as in hospitals with chronic pulmonary tuberculosis. One case had an excellent chest condition, but is under treatment now for an acute osteomyelitis of the left tibia (*staphylococcus aureus* in both conditions). One case died two months after discharge of meningitis, one case is still under observation—nine-months interval with a discharging sinus, due to osteomyelitis of the rib, with limitation of chest expansion, but is improving slowly.

Three cases were submitted to secondary operation chiefly because of failure of the sinuses to close, and the secondary operations were those for chronic empyema, in one an enlargement of the drainage opening with satisfactory cure, in two chest collapsing operations, one with a satisfactory cure, and one which still has a discharging sinus.

In this group as in the streptococcus group, one is impressed by the fact that the underlying lung condition and the character of the infecting organism have an important influence upon the outcome of the case.

In this series late complications and sequels (such as acute osteomyelitis, osteomyelitis of the rib, meningitis, etc.) have been more common than the pneumococcus infection.

There were seven cases in which the bacteriological report does not identify the organism sufficiently to place it in any of the above groups (that is, the report states Gram-positive cocci, Gram-positive diplococci, Gram-positive diplococci with capsule, etc.).

While it was possible to conjecture what was meant, it seemed wisest to the writers to place these cases in a separate group.

The preceding condition is stated as pneumonia in four, not known in two, and measles-pneumonia in one case.

Three cases died, all of which were pneumonias. One of the fatal cases had a complicating gastroenteritis, and one had a serofibrinous pleurisy on the opposite side.

Of the four cases which recovered one case was discharged cured but could not be traced. Two had excellent results and one case had a discharging sinus with limited chest expansion after two and one-half years. This last case had three secondary operations, the first for insufficient drainage, and the other two for a chronic empyema.

In twelve cases the culture from the chest was reported as sterile. The preceding condition is stated as pneumonia in eight, influenza in one, pleurisy in one, measles-pneumonia in one, perforated gastric ulcer in one.

Four cases died, three of which were pneumonias. One was practically moribund on admission and died soon after the operation, two had pericardial effusions which were aspirated, one died of a diffuse

peritonitis with perforation of the intestines. The suppurative pleurisy in this last case was a complication of a perforated ulcer in the pyloric region.

Of the eight cases which recovered, one could not be traced, five had an excellent result, one had signs of thickened pleura, one had an asthmatic cough which had existed previous to the empyema with râles over the affected side of the chest.

Two of the above cases were submitted to secondary operations because of insufficient drainage. (In one case the tube had fallen into the chest.) Both cases were satisfactory recoveries.

In twenty-four cases there was no bacteriological report on the chart. (Many of these were cases during the disorganization at the beginning of the war.)

The preceding condition is stated as pneumonia in fourteen cases, influenza in four cases, pleurisy in two cases, acute appendicitis in two cases, chicken-pox in one case, and in one case the preceding condition could not be determined.

Four cases died (three were pneumonias). One died shortly after the operation and two died with complicating conditions elsewhere than in the chest (otitis media, abscess of the thigh). One case was an acute appendicitis with suppurative pleurisy which died the day after the operation for the later condition.

Of the twenty cases which recovered, one case died six weeks after discharge from the hospital of meningitis, and one died three months later of intestinal obstruction. (This case was originally an acute appendicitis complicated by suppurative pleurisy and abscess of the liver.) Thirteen cases are reported in excellent condition with no lung signs, one had thickened pleura on the affected side, four were discharged with a discharging sinus and could not be traced.

Five of the above cases were submitted to secondary operations. In three the drainage wounds were allowed to close too rapidly and had to be reopened on the twenty-first and twenty-third and twenty-fifth post-operative days. In one case the patient was well for five months and was then readmitted ten months after the first operation with a suppurative pleurisy on the same side. In one case (one of the pleurisies) a secondary operation was done, evidently for unsatisfactory drainage, and the description of the condition suggests that the underlying disease was tuberculous, but there are no definite statements. (The case was one that left the hospital with a discharging sinus and could not be traced.)

In one case the fluid aspirated from the chest was stated as thick pus and the bacteriological report was bacillus typhosus in pure culture. The case is of sufficient interest to report in detail.

The patient, an Italian aged forty-one years, was admitted to the First Medical Division (Doctor Connor's service) of the New York

TREATMENT OF ACUTE SUPPURATIVE PLEURISY

Hospital, February 19, 1920. His chief complaints were cough, pain in the right chest, fever and weakness. The onset was characterized by general malaise, pain in the back and legs, headache and cough with no sputum.

His condition has steadily grown worse and the pain in the right chest has slowly increased.

Physical examination showed a man who looked sick, was apathetic and unresponsive. Examination gave dulness and the signs of fluid on the right side. The spleen was barely palpable. The temperature on admission was 103° ; pulse, 100; respiration, 20. Blood: Hæmoglobin, 56; red blood-cells, 3,176,000; white blood-cells, 8000, with 65 per cent. polynuclear cells.

(Doctor Connor expressed the opinion that the patient had the appearance of a patient with typhoid.)

Aspiration of the right chest on the day after admission removed 500 c.c. of frank pus, which on culture revealed the bacillus typhosus in pure culture. Aspiration on the fifth day after admission again gave pus. X-ray on second day after admission showed fluid (pus) in right chest (Doctor Busby).

Operation (February 24, 1920, five days after admission).—Thoracotomy with Kenyon siphonage drainage. Doctor Hitzrot, novocain infiltration anæsthesia, incision in seventh interspace in posterior axillary line, sufficiently large to admit a large rubber tube. Kenyon siphonage drainage. A large amount of pus escaped into the bottle. Kenyon drainage for nine days—saline irrigations caused chill. Later Dakin-Carrel irrigations which could not be continued because of coughing; discharged sixty-nine days after operation with chest wound healed except for small superficial granulating area.

The temperature curve, pulse, and respiration showed nothing of moment and resembled the period of steep curve seen in the typhoid charts.

Widal and blood cultures were negative.

(*Bacteriological Report*.—The culture from the chest fluid shows a growth of a Gram-negative bacillus which is motile and which has the cultural characteristics of the bacillus typhosus. It is agglutinated by antityphoid serum in dilutions of 1-1000-1-5000.)

SUMMARY

1. In the cases of suppurative pleurisy due to the pneumococcus proper drainage instituted early and maintained long enough produced a satisfactory cure.

2. In the cases of suppurative pleurisy due to the streptococcus there were more underlying lung conditions (abscess, etc.) which required more varied treatment, and secondary operations were more frequent.

3. The average stay in the hospital for the uncomplicated cases in this series was thirty-two days. This includes the case due to the bacillus typhosus but not the deaths, the unsatisfactory results, or the cases submitted to secondary operations.

HITZROT AND WEEDEN

	Number of Cases	Preceding Disease	Cases	Deaths	Not Traced	Excellent	Some disturbance of chest function not healed, etc.	Secondary Operations	Remarks
Pneumococcus	32	Pneumonia.....	27	3	4	20	5	7	Chiefly for insufficient drainage
		Measles.....	2	..	..	..	..
		Influenza.....	3	..	..	..	..
		.....	..	(9.3)	..	(62.5)	..
Streptococcus	22	Pneumonia.....	10	1	5	Chiefly for underlying lung conditions.
		Influenza.....	4	..	..	..	..
		Broncho-pneumonia...	2	..	2	12	5		
		Measles, pneumonia..	2	..	..	..	..
		Tuberculosis, broncho-pneumonia.....	1	1	..	..	..
		Pneumonia after tonsillectomy	1	..	..	..	..
		Pleurisy.....	1	..	..	..	..
		Infarct.....	1	1	..	..	..
Staphylococcus	12	(13.6)	..	(54.5)	..	3	Chronic empyema.
		Pneumonia.....	5	1	..	..	..
		Measles, pneumonia..	1	..	2	4	4		
		Broncho-pneumonia..	1	1	..	..	..
		Influenza-pneumonia..	4	..	..	..	..
Organisms not sufficiently identified...	7	?	1	3	Chronic empyema.
		.....	..	(16.6)	..	(33.0)	..
		Pneumonia.....	4	3	1	2	1		
		Unknown.....	2	..	..	..	..
Sterile.....	12	Measles, pneumonia..	1	2	Insufficient drainage.
		Pneumonia.....	8	3	1	5	2		
		Influenza.....	1	..	..	..	..
		Pleurisy.....	1	..	..	..	..
		Measles, pneumonia..	1	..	..	..	..
		Perforated gastric ulcer	1	1	..	..	..
No report....	24	(33.0)	..	(41.0)	..	2	Pericardial effusions, fatal.
		Pneumonia.....	14	3	..	..	..
		Influenza.....	4	..	..	..	..
		Pleurisy.....	2	..	..	..	..
		Acute appendicitis....	2	1	4	13	3		
		Chicken-pox.....	1	..	..	..	..
Bac. typhosus	1	Unknown.....	1	
		?	1	..	..	1	..
Diphtheroid bacillus.....	1	Pneumonia.....	1	1	
		Cardiovascular disease with decompensation		
III			III	19	14	57	21		

DUODENAL ULCER IN INFANCY

BY DUDLEY WHITE PALMER, M.D.

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IF THE diminutive size of the bibliography of this subject be a criterion as to the rarity of duodenal ulcer in infancy, then it should rank amongst the most rare of diseases. However, a study of even this scant bibliography leads one to the conclusion that here, as so often is the case, this condition will be found less and less rare as one looks for cases; it is perhaps more unlooked for than uncommon. A majority of the text-books of pediatrics either do not mention the condition at all, or in a very few words pass it over as one of the causes of melena neonatorum. Even Moynihan in his monograph on "Duodenal Ulcer" gives as a title to his chapter on ulcer in infants, "Melena Neonatorum and Duodenal Ulcer."

L. Emmet Holt, in December, 1913, collected ninety-one cases in the literature and added four of his own. Seventy-four of these cases were published after 1908. In reviewing this literature it is interesting to note that one clinical feature, hemorrhage, is made to stand out preëminent and a necessity to diagnosis. One who has seen much of ulcer in adults cannot help but feel the building up of a diagnosis about one complicating symptom is a mistake, for in the ulcer of adults not over 40 per cent. of cases give a history of hæmatemesis or bloody stools, and it is difficult to see that hemorrhage is any more necessary to the making of a diagnosis in infants than in adults.

A study of forty-five case histories that I have been able to chart from the literature showed twenty-five males with an average age of about three and a half months. Practically all of the cases showed a more or less marasmic condition, though of a great many of the cases it is stated they had had a good start, often breast-fed, and but few dietetic errors had been present.

Helmholz and Gerdine, after a thorough study of the reported cases, and a careful bacteriological study of the ulcers found in eleven cases in their own clinic, came to the conclusion that the ulcers were of infectious origin occurring most commonly in epidemic form, and that a diplococcus or streptococcus was the invader. From one case a pure culture of streptococcus viridans was obtained, and this, injected into dogs and rabbits, produced ulcers of the duodenum in the hosts. It seems that the fundamental factor in the production of these ulcers is as in all ulceration, an infection. From the case histories it would seem that a debilitated state of health favored the infection. Not a few of the articles offer the ulcer as a complication of the marasmic, atrophic, anæmic condition and not a distinct entity. In no case in the literature is the cause attributed to burns.

With an average age incidence of three and a half months, and but

five of sixty-five cases being over five months old, one is struck by the uniformity of the age of these babies. As before mentioned, the history of gross dietetic errors is usually absent and was in the case I later report; not infrequently the babies have had the scientific care of a competent pediatrician, and the nutritional disturbance preceding the terminal complication of hemorrhage has seemed out of proportion to the dietetic fault. In fact, acute gastrointestinal disturbance is usually absent.

The vomiting is often severe and persistent, being irregular at times or assuming the type seen in true congenital pyloric stenosis of infants. In a canal whose lumen normally is not much larger than a lead pencil it can be readily understood how an ulcer just distal to the pylorus might produce sufficient irritation to cause a reflex spasm simulating pyloric stenosis even though no hyperplasia of the muscle existed. Vomitus was of soured food not containing blood, as a rule, until near the end of the scene; a majority of those that showed hæmatemesis or large, tarry stools died in thirty-six to forty-eight hours. It is surprising how little blood these young babies can afford to lose without dying. Not infrequently the vomiting has led to a diagnosis of congenital stenosis with and without confirmation of this diagnosis at autopsy. Rarely has the tumor of pyloric stenosis been found associated with ulcer, and the same may be said of gastric waves. If one will bear in mind that pyloric stenosis is essentially a disease showing itself in the first weeks of life, while ulcers come in the second to six months, there will be less confusion. Symptoms resembling stenosis appearing after two months should put one on his guard for ulcer as the more probable explanation of the symptoms.

There is, not infrequently, the usual evidence of pain shown by the crying, facial expression and drawing up of the knees. Bloody stools have been a common terminal symptom and, in fact, the few cases diagnosed clinically were so diagnosed upon appearance of bloody, tarry stools, in the absence of acute ulcerative colitis. Occult blood may be found in the stools when not macroscopically present, and it seems that it would be wise to examine the stools for occult blood in any case of unexplained vomiting continuing over a period sufficiently long to produce an atrophic condition.

Associated with these symptoms, of course, are all the symptoms of a bad nutritional disturbance, loss of weight, anæmia, dehydration, sunken fontanelles, subnormal temperature, suppression of urine, etc. The duodenal tube has been used for diagnosis several times and seems of value, but must be used with extreme care, as these ulcers are but poorly protected and not a few of the deaths in the reported cases were due to a natural perforation of the ulcer. Perforation did not follow the use of the tube in the recorded cases.

Of the forty-five cases I have charted, a correct clinical diagnosis was made or suspected in but ten, so it is very evident there is much room for improvement in diagnosis. The X-ray has been suggested, but not used

DUODENAL ULCER IN INFANCY

as far as I know, and it seems that the X-ray might be of great value in the diagnosis if used in those cases of vomiting of infancy of obscure origin not responding to the usual dietary measures.

The ulcers of infancy may be single or multiple; they are usually just distal to the pylorus, but may be as far down as the papilla of Vater; the latter location is as rare as in the adult. Thirty-two of forty-five cases were in the first part of the duodenum and in sixteen instances the ulcers were multiple. No cases are reported with the ulcer below the papilla. This rather conclusively demonstrates that in addition to other etiological factors the chemical condition of the tract plays a big factor in the ulcer development. These ulcers may represent a superficial necrosis of the mucosa or show necrosis of all layers of the wall so that perforation occurs: a potential perforation has been plugged by the pancreas or omentum in rare instances. The ulcers range from small multiple erosions, the size of a pinhead, to large single or double ulcers, $1\frac{1}{2}$ centimetres long.

An absence of round-celled infiltration seems characteristic of these cases; any induration is rather more oedematous than inflammatory. Not infrequently a few clots of blood are adherent giving evidence as to the source of the hæmatemesis or bloody stools. A large majority of these ulcers are described as being on the posterior wall of the duodenum. The edges may be sloping rather than undermined, or in a few instances they are described as sharply defined and having a punched-out appearance. Associated pathology has consisted of cicatricial stenosis, congenital stenosis, nephritis, marked eczema, peritonitis local and general, fatty liver, pulmonary tuberculosis, jaundice, pneumonia, pus meningitis, colitis, melena neonatorum, marasmus, and emaciation.

The source of our knowledge of infantile duodenal ulcer being almost entirely the autopsy room, our ideas of prognosis will naturally be correspondingly colored. Certain it is that massive bleeding warrants a very poor if not promptly fatal prognosis. There are a few cases, however, that have been observed and diagnosed clinically that have gotten well, so that one wonders if they do not occur much more frequently than we have suspected in the past.

Well-healed scars have been found and in one instance the ulcer was quite well healed one week after a severe hemorrhage. It would seem that the majority of the ulcers are of an acute type. On the whole the prognosis must be considered poor, because of the associated nutritional disturbances and the well-known poor way an infant stands the loss of even small amounts of blood. Certainly the fact that most of the case reports in literature are accompanied with autopsy reports speaks but too plainly of the prognosis under the treatment used to date, and some radical change in the treatment is indicated. Perhaps not a few of the marasmic cases of unexplained etiology that ultimately improve and finally develop satisfactorily, are unrecognized ulcer cases. This paper

is, therefore, a plea to bear in mind this condition in these marasmic infants and so be in a receptive frame of mind toward this diagnosis should any suggestive symptoms present themselves.

On the consideration of the diagnosis of duodenal ulcer in the living infant one must bear in mind ulcerative colitis, chronic intussusception of the bowel, true congenital pyloric stenosis, swallowed pins or other foreign bodies, those marasmic and atrophic conditions not associated with ulcer, and that condition of melena neonatorum where the findings are multiple small ulcers throughout the intestinal tract. The post-mortem findings of ulcer must not only rule out the above, but also the post-mortem superficial necrosis or digestion that undoubtedly occurs rather rapidly in the poorly nourished.

Veeder says: "Surgical interference has not been deemed advisable in any of our cases, owing to the general nutritional disorder of the infants at the time diagnosis was made." His cases showed 100 per cent. mortality. He further adds: "If methods are found by which an ulcer can be recognized early, surgical treatment offers at least a theoretical possibility."

While it is presumptuous to draw conclusions from one case, it seems that in a condition as universally fatal as the reported cases in literature would indicate, some other more radical method of procedure is justifiable. In case of gross hemorrhage certainly a blood transfusion should be first indicated. A posterior gastrojejunostomy would then seem of value, where the exploration confirms the clinical diagnosis, as this operation is not only a drainage operation, but it alters the chemistry of the acid stomach. It would seem that the high percentage of complicating hemorrhage cases should alter one's attitude toward the use of any palliative methods of treatment.

The following case report, so far as I can determine from a rather careful search of the literature, is the first case of duodenal ulcer in infancy to be operated upon, and that successfully.

CASE REPORT. *Duodenal Ulcer in a Six-months-old Infant; Pyloroplasty, Followed Eighteen Days Later by Gastrojejunostomy; Recovery.* Baby E. V., male, six months old, weighed eight pounds at birth, was breast-fed for two and a half months. In the first few weeks he began spitting up food once a day or oftener and continued this until the last few months before operation when the spitting up became a true vomiting. At two months he reached a maximum weight of ten and a half pounds. Mother and baby had the "flu" when the child was about two and a half months old. Very many kinds of foods were given and after each change of food there was a temporary improvement in the vomiting; the case changed hands several times. About one month before I saw the child in consultation, Dr. E. A. Wagner took charge, and during this time very careful scientific feeding was instituted. Twice the duo-

denal tube was passed successfully. Weight fluctuated up and down until the early part of June, 1919, when the maximum weight of ten and one-half pounds was again reached only to be followed by daily loss of weight for nearly a week. Vomiting was worse rather than improved in spite of all the attention and care, and notwithstanding the days of apparent improvement the general average of his condition was much lower. The child was marasmic, dehydrated and more or less apathetic; the urine was scant, but the stools showed some food. At times the stools had been green and of deficient quantity. No one had seen blood in the stools, but tests for same had not been made. Hæmatemesis had not been noted. The X-ray showed a small, active stomach with about a normal emptying time. The character of the duodenal cap was not mentioned in the radiographer's report, and unfortunately the plates have been lost. On one or two occasions it was thought by Dr. Edward Wagner that peristaltic gastric waves were present, and at the time of my consultation it seemed that a wave could be outlined, though the mother says she and the father frequently looked for waves but never saw one. Certainly they were never definite as in the true case of congenital stenosis. Medical effort was failing to improve the condition and the child was rapidly losing weight, with a hot summer in prospect. A tentative diagnosis of congenital pyloric stenosis of a mild, persistent type was made and operation advised and accepted. At this time the child was six and two-thirds months old and weighed eight pounds and six ounces (six ounces over birth weight).

After one day's preparation with hypodermoclysis of normal salt solution and glucose and soda per rectum, the abdomen was opened at the Good Samaritan Hospital, June 20, 1919, Dr. Clyde Shinkle giving an ether anæsthetic. To our surprise no pyloric tumor was present. The pylorus was of normal thickness, but about one-half inch distal to the pyloric ring there was attached a tag of omentum plastered over an area of the peritoneum distinctly "stippled" and puckered as is the case in ulcers of adults. The child's condition was so bad a gastroenterostomy seemed out of the question, and a pyloroplasty operation was substituted, splitting the pylorus and suturing it up in the opposite direction to widen the lumen. The child reacted well, took some nourishment the first few days, vomited a few times, a bile-stained vomitus for the first time, and slightly more than held his own, so that by July 7th he weighed nine pounds. But the vomiting was becoming worse and food seemed to accentuate the vomiting. It seemed the lumen created by the pyloroplasty operation was insufficient, and I advised the parents to permit the more formidable gastrojejunostomy. I must confess I hoped they would refuse. Consent was again given and a rapid, short-loop, posterior suture gastrojejunostomy was made on July 8, 1919. This operation was very successful. I feel quite sure the pyloroplasty operation paved the way for the gastro-

jejunostomy, and also I am convinced the latter operation as the primary operation would have resulted fatally. The child gained steadily, and when sixteen months old he weighed twenty-four pounds and was a fine-looking child in every way. In doubling his age he tripled his weight. Now at the age of two years he weighs thirty-two pounds and is normal in every way.

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LINITIS PLASTICA

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IN THIS report the author purposes to consider, somewhat cursorily, the salient diagnostic and pathologic problems of linitis plastica. In general, the unsolved problems of stomach pathology, of which linitis plastica is a striking example, are of vital importance to the surgeon, especially when the question of the selection of a particular operative technic demands an immediate decision. In gastric ulcer, for example, this is well illustrated. The unknown pathogenesis of ulcer and its relation to carcinoma are mooted questions, to the solution of which any discussion of a problem of stomach pathology of surgical interest, must throw some light, however feeble. Incidentally, a knowledge of the occurrence and recognition of linitis plastica may possibly aid in the explanation of those not unusual instances of pyloric tumor in which later investigations or even autopsy disclose complete disappearance of the tumor, despite the fact that the growth was left either untouched or relieved merely by a palliative procedure.

CASE REPORT.—Male, aged fifty-one years. Admitted to the Rockaway Beach Hospital, December 3, 1919. Discharged January 1, 1920. Occupation, plumber.

Family History.—Close questioning fails to reveal that any member of the family suffered from diabetes, nephritis, carcinoma or tuberculosis. His father died of "chronic indigestion," at the age of sixty-nine years, following a period of emaciation. Brothers and sisters alive and well.

Personal History.—Polyuria three to four times a night. Smokes about twenty cigarettes a day; uses alcohol in moderation. His usual weight is one hundred and thirty pounds; at present he weighs one hundred and four, having lost approximately twenty-six pounds in one month. Habits regular. Denies venereal disease. In childhood suffered from measles, whooping-cough, mumps and diphtheria. Never been operated on. No history of any accident.

Chief complaint is the occurrence of pain in the epigastrium. This pain was first noted twelve years ago; is of excruciating character. For about one month previous to operation the pain has become exceedingly oppressive. It is confined to the umbilical region. Recently the pain has appeared one-half hour after meals. Nausea and vomiting constantly present.

Physical Examination.—Eyes are negative, save for myopia. Slight deafness in the left ear. A small polypus is present in the

nose. Heart and lungs negative. Examination of the abdomen fails to reveal any tumor or mass. The patient is a thin man, with marked evidence of loss of flesh. His chief complaint is abdominal pain in epigastrium. Urinalysis, negative. Wassermann examination, negative.

X-ray Report (September 10, 1919).—M. B. Bernstein, M.D. The stomach was large, dilated, hypotonic in type, presenting a hyperperistalsis; there was a definite, persistent defect at the pylorus. The six-hour examination showed a very large residue, indicating marked obstruction at the pylorus. The conclusion was that the patient had a chronic calloused ulcer at the pylorus with early malignancy.

Operation (December 6, 1919, Rockaway Beach Hospital).—Ether narcosis. An incision was made in the median line of the epigastrium. On opening the abdomen there was found a large tumor situated at the pyloric end, extending along the lesser curvature of the stomach. Several glands in the lesser omentum were distinctly involved. The liver appeared smooth to palpation. As there existed considerable mobility of the tumor without excessive lymphatic involvement, resection was decided upon. A typical partial gastrectomy of the Billroth No. 2 type was performed. The continuity of the intestinal tract was restored by supplementing the operation with a posterior gastrojejunostomy of the no-loop antiperistaltic type. In performing the gastrectomy the duodenal stump was closed with three layers of sutures. First, a running chromic catgut No. 2; second, a Cushing linen suture; third, interrupted linen sutures. The stump of the duodenum was brought in close approximation to the pancreas, following the advice of Willy Meyer.

The stomach was divided in an oblique manner and the opening closed with three layers of sutures. First, a running, inverting, chromic catgut suture No. 2; second, a Cushing linen suture; third, interrupted, mattress, linen sutures. The technic employed in the gastrojejunostomy was that recommended by William Mayo. At the conclusion of the operation a thin cigarette drain was placed through the upper angle of the incision and passed to the stump of the stomach. The abdomen was closed in layers. The duration of the operation was one hour and fifteen minutes. The patient's condition was excellent; pulse was about 80, full and strong.

Uneventful recovery. The drain was withdrawn promptly. Removing the sutures disclosed primary union. Patient was discharged from the hospital cured. At the present writing he is in splendid health and has completely regained his original weight and has resumed his work.

Pathological Report.—Ray S. Nelson, M.D. On examination of the gross specimen the tumor appears as a white, thick, intensely hard mass. On closer investigation it seems to involve the entire portion of the stomach removed. It would appear to have existed originally on the pylorus and extended downward on both the anterior and posterior walls of the stomach.

Microscopical examination reveals a very definite formation of fibrous tissue, some of which is extremely dense beneath the muscular layer. The fibrous tissue penetrates and involves the muscular layer and extends to the serosa. The mucous membrane is absolutely normal. The tumor is not carcinoma, sarcoma, myoma or a gumma. It should be classified, most likely, under the heading of linitis plastica. The slides of this specimen were shown to John Larkin, M.D., Pathologist, City Hospital, who concurred in the above diagnosis.

For an elaborate and detailed discussion of the history, etiology and pathology of this rare disease, one should consult the excellent statistical and analytical article of H. W. Lyle, published in the *ANNALS OF SURGERY*, 1920. A complete bibliography is there furnished. It may suffice to say here that the term linitis plastica was first devised and applied by Brinton, who definitely established the disease as a lesion, distinct and peculiar to the stomach. Though, before the time of Brinton, there were desultory reports scattered throughout the literature, these reports and cases lacked the sufficient and determining clearness necessary to stamp the disease as a clinical and pathologic entity. Moreover, the pathologic and microscopic records of the earlier cases are necessarily uncertain because of the then inadequate examinations.

The descriptive term, linitis plastica, applied by Brinton, etymologically, is of Greek origin. It refers to and describes the delicate and interlacing connective tissue of the submucosa so peculiar and characteristic of the lesion. Since the time of Brinton numerous authors have contributed clinical and pathological monographs in which are employed a multiplicity of descriptive terms. Among the more common of these are, chronic interstitial gastritis, sclerosis of the stomach, submucous hypertrophy, neurofibromatosis, etc. Naturally, this diversity of nomenclature illustrates vividly the mysterious and baffling nature of the disease. Indeed, the unknown elements of the disease have given rise to considerable speculation as to its causation and intrinsic nature. The subject has been approached by the internist, the pathologist and the surgeon, all of whom have advanced numerous theories. Senility, arteriosclerosis, tuberculosis, lymphatic obstruction, sarcoma, infiltrating epithelioma and diffuse carcinoma have been suggested as the essential elements. It is generally and indeed firmly believed, however, at the present time, that the disease is in no way related to carcinoma or sarcoma, but is, essentially, a peculiar and benign form of fibrosis.

The stomach as a whole is generally contracted and rigid, and presents a somewhat mottled appearance. The walls are excessively thickened and inelastic. Pyloric stenosis is unusual. The obstruction is caused by a gradual and uniform narrowing and approximation of the walls of the stomach. The thickness is mainly caused by the prodigious expansion of the submucosa. The muscularis and serosa take but a minor part in

producing the thickening, since the increase of connective tissue in the submucosa is the vital and dominant factor.

The striking histologic finding is the extreme hypertrophy of the connective tissue of the submucosa. The characteristic appearance of the connective-tissue fibrils, displayed by profuse and intimate interweaving, is especially distinctive and characteristic. These connective-tissue fibres exist in the form of swirls that invade and occupy the muscularis, and indeed extend to the serosa. Yet, despite this marked alteration of the submucosa the border of the mucosa remains intact and uninjured. This smooth and undisturbed appearance of the cylindrical cells of the free surface of the mucosa is especially emphasized by Lyle. He maintains that the absence of necrosis or ulceration of the mucous membrane is a striking and pertinent point. Of course, from excessive pressure of the newly formed elements in the submucosa, the mucosa may become thickened or even atrophied, with the development, occasionally, of dilated or cystic gastric tubules. The changes, however, are extremely insignificant. This striking absence of alteration of the mucosa places the lesion in marked and special contrast to carcinoma of the stomach. For in adenocarcinoma the salient and dominant alteration is the change and growth of the cylindrical cells either covering the surface or lining the ducts and glands.

The actual diagnosis is usually made by the pathologist. A correct pre-operative diagnosis is practically impossible, though it is interesting to note that Osler had the distinction once of diagnosing the condition. The symptomatology is in no way clear. Indeed, it is difficult to record a precise clinical train of symptoms. In general, the signs are vague and indefinite and resemble, more or less, those of gastric carcinoma.

The disease usually occurs in adults. A previous history of arteriosclerosis, chronic alcoholism, rheumatism and diabetes has been recorded in certain published cases. The usual symptoms noted are anorexia, vomiting, epigastric pain and tenderness, and occasionally the finding of an abdominal tumor. Vomiting is liable to become intractable. Gastric analysis does not furnish any decisive point. X-ray examination of the stomach is informative. The disease is progressively fatal unless relieved or cured by surgical operation.

The treatment is surgical. Since the diagnosis is never definitively determined until the microscopic examination has been completed, the general rules and principles underlying the surgical treatment of carcinoma of the stomach are maintained for linitis plastica. In short, if the technical conditions permit, gastrectomy, partial or complete, should be performed. If, owing to the debilitated condition of the patient, or the occurrence of extensive adhesions to the adjacent viscera, gastrectomy is not feasible, gastrojejunostomy is indicated, especially if there exist pyloric stenosis. It would appear that the latter operation is often curative. Still, the extreme difficulty in recognizing the lesion and its great

liability to resemble carcinoma, undoubtedly, make gastrectomy the operation of choice. Moreover, the uncertain nature of the disease and its potential alteration to carcinoma furnish additional points in sustaining a decision to perform gastrectomy.

As is evident by the recital of the above case, the symptoms and X-ray picture pointed toward pyloric carcinoma. Indeed, the actual pathologic findings at the time of exploration seemed indubitably those of pyloric carcinoma. It was never doubted for a moment that gastrectomy was clearly indicated. While complete recovery of the patient supports the practice of gastrectomy, it would appear from the investigations of Lyle that a gastrojejunostomy may prove equally successful. Since from the viewpoint of actual practice it would appear extremely difficult to discriminate these instances of linitis plastica from actual carcinoma, the writer feels that from this standpoint it would be better to employ gastrectomy in these doubtful instances.

In an article in the *ANNALS OF SURGERY*, July, 1913, Alexis Thomson describes fibromatosis of the stomach and its relationship to ulcer and to cancer. He employs the term fibromatosis as synonymous with linitis plastica as described by Brinton. Other terms mentioned are cirrhosis of the stomach and fibroid induration of the stomach. The article is strictly a pathologic analysis of a certain number of specimens, personal and collected. The primary point urged by Thomson is that he is able to distinguish in the walls of the stomach ordinary or common scar tissue from the tissue characteristic of fibromatosis.

He states that ordinary scar tissue invades the entire walls of the stomach irrespective of the various layers, while fibromatosis, on the other hand, arises in the submucosa and extends into the muscularis, causing therein a peculiar segmentation of the circular muscle. It is this fundamental distinction between scar tissue and the tissues of fibromatosis upon which is based the thesis of his article. For example, he states that out of nine cases of stomach tumor in which he found fibromatosis, there were seven which presented a distinct punched-out ulcer defect, while in the remaining two there was superficial ulceration over the greater part of the affected area. Moreover, in a certain small percentage of these ulcer fibromatosis cases he found evidence of carcinoma in the stomach wall or in the adjacent lymph-nodes.

Of course, these findings are in marked contradistinction to the views above enunciated; and, if these findings are confirmed and substantiated the entire discussion would have to be reopened and the question of fibromatosis be brought in relation to ulcer. There is no doubt that this subject affords a fertile field for further investigation and study, particularly from the pathologic viewpoint. Before one can definitely close the subject it will be necessary to have specific criteria in order to distinguish between the characteristic tissue of linitis plastica and the scar tissue secondary to ulcer or carcinoma of the stomach.

THE USE OF THE DUODENAL TUBE IN THE PRE-OPERATIVE STUDY OF THE BACTERIOLOGY AND PATHOLOGY OF THE BILIARY TRACT AND PANCREAS *

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THE duodenal tube has been in use as an aid to diagnosis since 1909, when Einhorn ¹ first demonstrated its clinical applicability. It is now accepted as the best means of obtaining duodenal contents for examination. Inasmuch as the stomach contents, the secretions of the pancreas, the bile and the duodenal secretion, and under certain conditions the contents of the upper jejunum, are to be found in the upper half of the duodenum, the examination of the material removed from the duodenum is open to many interpretations unless the conditions present at time of removal are known.

It has been established that in the normal individual in the fasting state the duodenum is collapsed, practically nothing passes from the stomach, very little bile enters it, and that the little fluid content present at that time is sterile. In the earlier work done with the duodenal tube little information could be obtained in the fasting state, unless the duodenum itself were diseased, or if the contents were removed in an active stage of digestion, with the stomach active the acid secretions of the stomach disturbed the duodenal contents as far as bile and pancreatic enzyme investigations were concerned.

In 1917, however, a very new and active interest was given to the study of duodenal contents from the standpoint of biliary and pancreatic disease. In April, 1917, Meltzer published a communication entitled "The Disturbances of the Law of Contrary Innervation as a Pathogenetic Factor in the Diseases of the Bile-ducts and Gall-bladder." ² In a footnote at the end of his article he said, "According to the view taken in this paper, some cases of jaundice and of biliary colic have their origin in the fact that the sphincter of the common duct is abnormally contracted and does not become relaxed as it physiologically should during the contraction of the gall-bladder. In experiments with magnesium sulphate I observed that the local application of a 25 per cent. solution of that salt upon the mucosa causes a completely local relaxation of the intestinal wall, and does not exert such an effect when the salt is administered by mouth, that is, when it has to pass through the stomach before it reaches the intestines. The duodenal tube, however, apparently has reached an efficient practical stage. I make, therefore, the suggestion to test in jaundice and biliary colic the local application of a 25 per cent. solution of $MgSO_4$ by means of the duodenal tube. It may relax the sphincter of the common duct and permit the ejection of bile and perhaps even the removal of a calculus of moderate size wedged in the

* Read before the New York Surgical Society, February 9, 1921.

duct in front of the papilla of Vater. Twenty-five cubic centimetres of the solution as a dose for an adult will bring no harm. For babies the dose should not exceed 4 cubic centimetres. The procedure could be developed into a practical useful method."

To B. B. Vincent Lyon,³ of Philadelphia, belongs the credit of promptly putting to practical use Meltzer's very valuable suggestion. In September, 1919, he published the results of a two-year investigation along the lines suggested by Meltzer and has since added to his large series of cases, reporting them in several articles.^{3, 4, 5, 6} His investigations have dealt with biliary tract cases chiefly, both from diagnostic and therapeutic standpoints. The objection that may be made to the findings in his cases is that relatively few of them were checked by operative or autopsy findings. The technic he has evolved, based upon Meltzer's suggestions, is well thought out and practical. This technic has unquestionably opened up new sources of information in the diagnosis of biliary and pancreatic disease.

The test as suggested by Meltzer and carried out by Lyon presupposes: First, the sphincter action of the muscle of Oddi. Secondly, the Law of Contrary Innervation in the contraction of the gall-bladder with the relaxation of the muscle of Oddi. Thirdly, the specific action of magnesium sulphate in the duodenum in initiating the functioning of this law. So far as the writer has been able to ascertain, the actual experimental demonstration of Meltzer's hypothesis of the Law of Contrary Innervation as applied to the gall-bladder and sphincter of Oddi has not been accomplished. From Meltzer's paper one is led to the conclusion that his discussion was a philosophical one, and he does not state that he actually demonstrated the contraction of the gall-bladder with the relaxation of the sphincter. Lyon does not state that this has been proved by experiment.

Considerable doubt as to the validity of this hypothesis is expressed by Crohn,⁷ of the Mt. Sinai Hospital. He has tested the hypothesis experimentally in eight dogs by making a celiotomy, injecting methylene blue into the gall-bladder and applying $MgSO_4$ solution to the mucosa of the opened duodenum. In only one of the eight animals did he note any contraction of the gall-bladder with a discharge of methylene-blue colored bile from the papilla. That the papilla is relaxed as a result of $MgSO_4$ solution resulting in an increased flow of bile as stated by Lyon and many other clinical observers, has been corroborated in the series of cases here reported. McWhorter,⁸ of Chicago, has recently published experimental proof of this effect of $MgSO_4$ solution in reducing the resistance of the sphincter. In twenty-five dogs he found the average resistance of the sphincter of Oddi to be between 120 and 200 mm. of water. Application of a 25 per cent. $MgSO_4$ solution reduced the resistance from 50 to 100 mm. of water. He states that it produced a transient but not a complete or total relaxation. Unfortunately he makes no mention of whether or not there was a synchronous contraction of the gall-bladder.

In the series here recorded the test has been applied to biliary cases

in which the gall-bladders were so diseased as to preclude any normal emptying due to contraction of the musculature of the gall-bladder wall. The writer, therefore, holds no brief for or against Meltzer's hypothesis in the normal individual. But in this series, where the common duct was not obstructed, $MgSO_4$ solution instilled into the duodenum caused an accelerated flow of bile. That the bile thus obtained lends itself to bacteriological study would seem to be a valid surmise, and an organism thus obtained, in pure culture, might well be considered an etiological factor in the diseased biliary tract. The studies of Nichols, Simmons and Stimmel,⁹ and of Henes¹⁰ in duodenal cultures of typhoid carriers have conclusively proved the advantages of the duodenal tube in studying the bacteriology of the bile as an indication for surgical therapy.

In reading Lyon's first paper, the writer was impressed, not by the claims made for the method as a therapeutic measure, but by the opportunity the method offered in surgical cases to study the bacteriology of the biliary tract and chemistry of the pancreatic enzymes in the duodenal tube contents before operation, these findings to be checked by the operative findings in the bile, gall-bladder and common duct, gall-bladder tissue, and the pancreas. With this in mind, the writer began to use duodenal intubation in all his biliary cases before operation. Many of the early cases were excluded from this series, because of faulty technic. For this reason the series is small and the facts presented are analyzed for the purpose of stimulating interest in a subject that may prove of real value with cumulative evidence of other investigators.

In forty patients duodenal intubation was accomplished. In eight cases the tube failed to reach the duodenum. The effect of $MgSO_4$ instillation can be compared with the operative findings in intubations performed in twenty-five cases. In twenty-six patients the pre-operative pancreatic ferment tests can be compared with the condition of the pancreas as determined by palpation at time of operation. In twenty-five cases the pre-operative cultures of the duodenal contents can be compared with the cultures of gall-bladder or common-duct bile or gall-bladder tissue. It may be stated that the pathology of the gall-bladder, the ducts, the pancreas, liver and lymph-nodes was more meticulously observed and recorded than in the average case. Every effort was made to rule out error by sending the specimens of duodenal contents and of bile and gall-bladder tissue to the laboratory as soon as possible and with as aseptic technic as we could devise. The following is the procedure in use at present:

The duodenal tube and tip is of the Einhorn type and has given the best results of several others tried. The technic of preparing the tube and feeding it to the patient is in general that of MacNeal and Chace.¹¹ We are using salol instead of shellac for coating the capsule. The tube is boiled, the tip is covered with a gelatin capsule sterilized in alcohol and then coated with salol, and is given to the patient in the prone position, ten

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to twelve hours after the last meal. The salol is not dissolved until the tip passes into the duodenum. Until an alkaline, bile-covered fluid is obtained by suction with a Luer syringe, the bulb is not considered to be in the duodenum. After this type of fluid is collected in a sterile test-tube and marked "D" or "Duodenal," twenty cubic centimetres of a sterile 30 per cent. $MgSO_4$ solution is injected through the tube into the duodenum. After the darker green viscid "B" or gall-bladder bile begins to drip rapidly from the tube, a specimen is collected in another sterile test-tube and marked "B." After the flow has resumed a lighter yellow a third specimen or hepatic bile is collected and marked "C." The tube is then drawn into the stomach and a specimen is saved to be tested for acidity, free and combined.

"DUODENAL BUCKET" TEST

Salol coated gelatin capsule not used
Hot sterile broth not given
Tube swallowed without difficulty at
First return at
Duodenal contents at

Reaction

Color

Analysis of gastric return:

Appearance

Total acidity

Guaiac

Microscopic

Free HCl

Lactic acid

Ante Op.

Post Op.

Duod. Contents (D); G. Bl Contents (B); Liver Bile (C); G Bl Bile GB; Wall no marked effect from $MgSO_4$

	D	B	C
Appearance:			
Color.....			
Turbidity.....			
Viscosity.....			
Rate.....			
Amount.....			
Reaction.....			
Gritty particles.....			
Microscopic:			
Cholesterin cryst.			
Pus.....			
Bacteriology:			
Aërobic culture.....			
Anaërobic.....			

Pancreatic ferments:

Digestion (none, weak, moderate, full)

1. Amylase
2. Protease
3. Lipase

The three bile specimens are sent to the Bacteriological Laboratory and from there to the Chemical Laboratory. The findings are recorded on the accompanying chart which was devised by Dr. M. Melicow of the present House Staff of the Presbyterian Hospital. Unless there is a systematic recording of positive and negative findings, the notes in the cases are

sure to be deficient when summarized. The findings in these cases may be grouped under the following headings:

1. Bacteriological.
2. Chemical.
3. The Comparison of the Results of MgSO_4 Instillation with the Lesion found at Operation.

Bacteriological Findings.—Before stating the results in this series it is of interest to note that before the invention of the duodenal tube several investigators had studied the bacterial content of the duodenum. As early as 1886, Escherich¹² found that in the fasting state or when only intestinal juices were present, the upper intestine in children was practically sterile. Cushing and Livingood¹³ corroborated these findings in their investigations in humans at time of operation and in animals. Hess¹⁴ in 1912 studied fifteen infants by means of the duodenal tube and found colon bacillus in the fasting duodenum of only one child. He suggested the use of the duodenal tube in studying the duodenal flora of adults. In 1913, MacNeal and Chace¹¹ reported their duodenal tube study of the fasting duodenal contents of twenty-four adults from the bacteriological standpoint. Their technic was painstaking and their bacteriological study, both qualitative and quantitative, was elaborate. Their conclusions were:

1. It is possible, with proper care, to obtain a sample of the intestinal juice through the Einhorn duodenal tube sufficiently free from contamination for bacteriological study.
2. The normal duodenal fluid during a fast is almost free from living microörganisms, although numerous bacterial cells are always visible on microscopic examination. The few living microbes obtained in cultures from such fluids are generally Gram-positive cocci.
3. In various gastrointestinal disturbances the number of cultivable microbes in the duodenal fluid is markedly increased. These organisms are of several different varieties, bacilli, cocci, yeasts and branching thread forms being represented in different cases.
4. In the one case of typhoid fever examined, *B. typhosus* was isolated from the duodenal fluid.
5. The bacteriological study of intestinal juice obtained in this way would seem worth while in cases of achylia gastrica with diarrhoea and in cholecystitis. It also seems to us to be a promising field for investigation in those obscure diseases, the causation of which is sometimes ascribed to abnormal intestinal digestion.
6. It may also, perhaps, prove to be a procedure of value in the early diagnosis of typhoid fever and in the detection of typhoid carriers. We think it should be given a trial in this disease, as suggested by the previous work of Hess.

In August, 1920, Einhorn and Meyer¹⁵ published a report on eighteen cases studied at the Lenox Hill Hospital pre-operatively by the duodenal tube. In this series MgSO_4 instillation was not done through the duodenal tube, cultures were not made of the pre-operative bile for comparison with cultures of bile and gall-bladder tissue taken at operation. In one of the eighteen cases *B. coli* was recovered in the bile from the excised gall-bladder, in two the bile was reported sterile.

In the study of MacNeal and Chace,¹¹ the cases were very largely of the gastroduodenal type and only one case of cholelithiasis or biliary duct disease was cultured. None of the cases in the writer's series, except one, showed any evidence of duodenal ulcer. All showed some lesion or other of the biliary tract. Obviously the bacteriological findings in duodenal contents of fasting patients giving a history and physical signs of a biliary tract lesion are of more interest if checked by the cultures of the bile, gall-bladder tissue and gall-stones. But it is necessary to bear in mind the sources of error in the technic and existing conditions of such a bacteriological investigation. The duodenal bile may be contaminated by mouth organisms carried down in the efforts to swallow the tube. The salol coated capsule covering the bulb eliminates a great deal of the contamination, but not entirely. The necessary handling of the gall-bladder in the operative procedure may conform rigidly to surgical asepsis, but not necessarily to bacteriological asepsis. The use of freshly flamed instruments and a seared surface in excising gall-bladder tissue from the specimen conforms to the requirements of tissue culture. Delays in delivering the specimens to the bacteriologist have been guarded against in this series, but in some cases this error has resulted probably in sterile cultures.

A study of the analysis chart (Chart I) will show that the above sources of error, our efforts to eliminate them notwithstanding, have vitiated the comparison of preoperative and operative cultures in many of the cases. Thus there are conflicting findings in about half of the cases. These are not necessarily due to errors in technic however.

It is interesting to note that in about fifty per cent. of the cases one or more varieties of bacteria found in the preoperative duodenal bile were present in the gall-bladder bile or gall-bladder tissue. In some of these, however, contaminations are suggested by the variety of or type of organism.

The presence of *B. subtilis*, *streptococcus salivarius* and *micrococcus catarrhalis* or other mouth saprophytes may be regarded as contaminations in the duodenal cultures. On the other hand the colon bacillus, the hæmolytic streptococcus and staphylococcus aureus, especially if found in the bile following MgSO_4 instillation, may be considered as etiological factors and as probably present in the gall-bladder or common duct, or both if "B" bile is obtained. It is the writer's impression from a study of these cases, as well as some one hundred and fifty cases in which gall-bladder bile and tissue from gall-bladder was cultured, that the colon bacillus is the most persistent of the bacteria found in the common duct. In three cases the colon bacillus has been recovered in pure culture from the common duct of cholecystectomized patients four months, one year, and six years after operation. In these patients *B. coli* was cultured from the gall-bladder or common duct bile at time of operation. Rehfus and Lyon have noted this type of persistent infection and advise autogenous vaccine therapy. In this type of case, and after any severe cholangitis relieved by hepatic drainage, the writer agrees with Lyon that duodenal MgSO_4 instillation

CHART I
Bacteriology in 25 Cases

History No.	Patient	Sex	Culture of			Lesions found at operation	Culture of gall-bladder tissue	Culture of gall-bladder bile	Culture of common duct bile
			Duodenal bile	"B" or gall-bladder bile	"C" or common duct bile				
47011	E. S.	F	Non-hæmolytic strep. B. coli communis Staph. pyogenes aureus	None obtained	Non-hæmolytic strep. B. coli communis Staph. aureus	Gall-bladder tense, cystic duct closed. Many faceted stones. Gall-bladder adherent to colon and duodenum. Pancreas not pathological on palpation. Gall-bladder thick, adherent to duodenum. Contained many calculi and mucoid material. Pancreas felt normal. Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas felt normal. Gall-bladder showed marked thickening, full of calculi. Common duct dilated. No stones found in common duct. Pancreas not enlarged. Duodenal tube passed 1 month after operation because of symptoms of chronic pancreatitis, although jaundice had entirely cleared and biliary fistula had closed.	Non-hæmolytic strep. B. coli communis, staph. aureus B. fecalis alkalig.	Non-hæmolytic strep. B. coli communis, staph. aureus B. fecalis alkalig.	Non-hæmolytic strep. B. coli communis, staph. aureus B. fecalis alkalig.
46382	E. M.	M	No growth	None obtained	Staph. albus	Gall-bladder chronically inflamed, contained many calculi and mucoid material. Pancreas felt normal. Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas felt normal. Gall-bladder showed marked thickening, full of calculi. Common duct dilated. No stones found in common duct. Pancreas not enlarged. Duodenal tube passed 1 month after operation because of symptoms of chronic pancreatitis, although jaundice had entirely cleared and biliary fistula had closed.	Staph. albus	Tube broken	
46666	H. W.	F	B. proteus Streptococcus	B. proteus	B. proteus	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas felt normal. Gall-bladder showed marked thickening, full of calculi. Common duct dilated. No stones found in common duct. Pancreas not enlarged. Duodenal tube passed 1 month after operation because of symptoms of chronic pancreatitis, although jaundice had entirely cleared and biliary fistula had closed.	B. proteus	B. proteus	
46813	J. K.	M	Non-hæmolytic strep. or enterococcus B. coli communis	None obtained	Staph. aureus	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas felt normal. Gall-bladder showed marked thickening, full of calculi. Common duct dilated. No stones found in common duct. Pancreas not enlarged. Duodenal tube passed 1 month after operation because of symptoms of chronic pancreatitis, although jaundice had entirely cleared and biliary fistula had closed.	Non-hæmolytic strep. or enterococcus B. coli	Non-hæmolytic strep. B. coli	
46813	J. K.	M	Enterococcus, B. coli	None obtained (Specimens obtained 1 month after operation)	Enterococcus, B. coli	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas felt normal. Gall-bladder showed marked thickening, full of calculi. Common duct dilated. No stones found in common duct. Pancreas not enlarged. Duodenal tube passed 1 month after operation because of symptoms of chronic pancreatitis, although jaundice had entirely cleared and biliary fistula had closed.	No growth	No growth	
46732	B. B.	M	Staph. aureus	MgSO ₄ not used	.....	Gall-bladder chronically inflamed, contained many calculi. Cystic duct closed. Pancreas nodular, enlarged. Patient is a diabetic. Gall-bladder tense, contained many calculi. Cystic duct closed. Gall-bladder chronically inflamed, adherent to duodenum. Cystic duct closed. Many calculi in gall-bladder. Head of pancreas nodular. Gall-bladder chronically inflamed. Emptied slowly. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	No growth	No growth	
46823	A. H.	F	Staph. albus	No "B" bile obtained	Rate accelerated, staph. albus	Gall-bladder tense, contained many calculi. Cystic duct closed. Gall-bladder chronically inflamed, adherent to duodenum. Cystic duct closed. Many calculi in gall-bladder. Head of pancreas nodular. Gall-bladder chronically inflamed. Emptied slowly. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	Non-hæmolytic strep.	B. coli communis	
46318	A. L.	M	No growth	None obtained	Rate accelerated. No growth	Gall-bladder chronically inflamed, adherent to duodenum. Cystic duct closed. Many calculi in gall-bladder. Head of pancreas nodular. Gall-bladder chronically inflamed. Emptied slowly. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	No growth	No growth	
45660	K. R.	F	B. subtilis	Slow change from yellow to dark green bile B. subtilis	B. subtilis	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	Sterile	B. coli communis	
45289	M. I.	F	B. coli communis	None obtained	B. coli communis	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	No growth. Specimens were placed in incubator too high for culture of bacteria.	No growth placed in incubator too high for culture of bacteria.	No growth in which temperature too high for culture of bacteria.
45289	M. I.	F	Non-hæmolytic strep., Gram positive bacillus	None obtained (cholecystectomy)	Non-hæmolytic strep., Gram positive bacillus	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	No growth	No growth	
45690	K. K.	F	Staph. albus, Gram neg. spore-bearing bacillus	No MgSO ₄ used	No MgSO ₄ used	Gall-bladder chronically inflamed, adherent to duodenum. No calculi found. Cystic duct patent. Pancreas not pathological. Gall-bladder thickened, contained many stones. Cystic duct closed. Pancreas enlarged, nodular at head. Duodenal tube passed for pancreatic ferments 3 weeks after operation because she developed diabetes. Gall-bladder chronically inflamed, contained calculi. Cystic duct patent.	Gram positive spore bearing bacillus	No growth	

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M. M.	F	No growth	MgSO ₄ not used	No growth	Chronic cholecystitis with calculi in gall-bladder	No growth	No growth	No growth
47248	M. M.	F	No "B" bile obtained	No growth	Chronic cholecystitis with many calculi in gall-bladder. Cystic duct closed. Pancreas felt normal	Gram positive bacilli	Gram positive bacilli	
47346	W. S.	F	No "B" bile	B. subtilis	Chronic cholecystitis. Shrunken gall-bladder containing gall-stones. Cystic duct closed	No growth	No growth	
47488	L. G.	M	No "B" bile	B. coli communis	Intrahepatic gall-bladder, fistula between gall-bladder and colon. Calculus in common duct. Chronic cholangitis. Head of pancreas thickened, hard	B. coli communis	B. coli communis	B. coli communis
47203	A. W.	F	No "B" bile	Non-hæmolytic strep.	Gall-bladder adherent to duodenum, contained many calculi. Pancreas large, hard throughout	Non-hæmolytic strep.	Non-hæmolytic strep.	Non-hæmolytic strep.
47414	J. H.	M	No "B" bile	Staphylococcus	Acute cholecystitis. Cystic duct closed by edema. Two calculi in gall-bladder	No growth	No growth	
47543	A. L.	F	No "B" bile	Strep. viridans staph. albus	Mucus fistula of gall-bladder. Cystic duct closed. (Cholecystostomy 2 mos. previously in another hospital)	Staph. albus	Staph. albus	
47544	M. H.	F	No "B" bile	No growth	Recurrent cholecystitis, five years after cholecystostomy. Gall-bladder densely adherent to colon, duodenum and anterior abdominal wall. No stones	Staph. albus	No growth	
48379	M. H.	F	No bile in alkaline contents. No response to MgSO ₄ . Pancreatic ferments all present	No growth	Congenital absence of gall-bladder. Common duct was obstructed by stones. Pancreas thickened at head	No gall-bladder found	No growth	No growth
47689	F. E.	F	No bile in the alkaline duodenal fluid containing pancreatic enzymes. No response to MgSO ₄ instillation	No growth	Operation for common duct reconstruction following stenosis of common duct with complete obstruction	Gall-bladder has been removed	No growth	No growth
44186	J. A.	M	No bile present in alkaline, white, viscid which were alkaline	No growth	Gall-bladder was contracted but not inflamed. Pancreas felt normal. Carcinoma of hepatic ducts causing complete obstruction	No bile found in gall-bladder	Gram positive bacillus	
48570	F. D.	F	No "B" bile	Non-hæmolytic strep. or enterococcus	Acute cholecystitis, empyema of gall-bladder with calculi. Cystic duct closed. Pancreas not palpated	Enterococcus or non-hæmolytic strep.	Enterococcus or non-hæmolytic strep.	
38214	C. B.	F	No "B" bile	No growth	Gall-bladder was contracted about many calculi. Cystic duct was closed. Pancreas was not pathological on palpation	No growth	No growth	
48773	A. G.	F	No "B" bile	Non-hæmolytic strep.	Gall-bladder distended with many calculi. Cystic duct patent. Many calculi in common duct. Liver cirrhotic. Pancreas not enlarged	Non-hæmolytic strep.	Non-hæmolytic strep.	Gall-stone in common duct cultured, non-hæmolytic strep.
48593	J. K.	..	No "B" bile	B. coli communis Enterococcus or non-hæmolytic strep.	Gall-bladder full of calculi. Cystic duct closed. Carcinoma of pylorus	B. coli, non-hæmolytic strep.	B. coli, non-hæmolytic strep.	

CHART II
Pancreatic Ferment Determinations in 26 Cases

Case No.	Initials	Sex	Amylase	Protease	Lipase	Lesion in pancreas	
47011	E. S.	F	Full digestion	Weak digestion	Weak digestion	Pancreas felt normal	Patient is a diabetic. Second duodenal intubation was done 6 weeks after operation
46813	J. K.	M	No digestion	No digestion	Weak digestion	Pancreas felt normal	
46813	J. K.	M	No digestion	Full digestion	Weak digestion	Developed symptoms of chronic pancreatitis after operation	
46732	P. B.	M	Good digestion	Very weak digestion	Q. N. S.	Pancreas nodular, enlarged	
46732	P. B.	M	No digestion	No digestion	Weak digestion	Urine showed sugar before coming to hospital but was sugar-free at time of operation	He came in for observation because of recurring symptoms of chronic pancreatitis
46823	A. H.	F	Good digestion	Good digestion	Good digestion	Head of pancreas indurated	
41764	F. P.	F	Good digestion	Very weak digestion	Not determined	Head of pancreas hard, enlarged	
45289	M. I.	F	No digestion	Good digestion	Good digestion	Head of pancreas large, nodular. Glycosuria after operation	
45600	K. K.	F	No digestion	No digestion	No digestion	Head of pancreas hard, nodular	
47346	W. S.	F	No digestion	Very weak digestion	Weak digestion	Pancreas felt normal	
47188	L. G.	M	Good digestion	Good digestion	Very weak digestion	Head of pancreas hard, enlarged	
47203	A. W.	F	Good digestion	Good digestion	No digestion	Entire pancreas enlarged, hard, <i>xndematous</i>	
47414	J. H.	M	Good digestion	Good digestion	Good digestion	Pancreas felt normal	
47544	M. H.	F	Fair digestion	Fair digestion	Weak digestion	Pancreas slightly indurated at the head	
47248	M. M.	F	Good digestion	Good digestion	Good digestion	Pancreas felt normal	
47177	M. M.	F	No digestion	Good digestion	Weak digestion	Pancreas felt normal	
47532	A. L.	F	Good digestion	Fair digestion	No digestion	Pancreas felt normal	She came in for treatment for diabetes which had developed since her operation
48279	M. H.	F	Good digestion	Good digestion	Good digestion	Pancreas hard, thickened at the head	
37542	F. G.	M	Weak digestion	Weak digestion	Weak digestion	Three years previously a cirrhotic pancreas had been found at operation	
48773	A. G.	F	Fair digestion	Full digestion	Good digestion	Pancreas not pathological on palpation	
38214	C. B.	F	No digestion	Full digestion	Good digestion	Pancreas not pathological on palpation	Patient came in with symptoms of an acute exacerbation which subsided. Cholecystectomy and choledochostomy 18 mos. previously
48593	J. K.	M	Full digestion	Full digestion	Full digestion	Pancreas not pathological on palpation	
39040	J. H.	F	Full digestion	Full digestion	Full digestion	Two years previously cholecystectomy, she then showed no thickened or enlarged pancreas	
48570	E. D.	F	Full digestion	Full digestion	Fair digestion	Pancreas not made out enlarged	
47689	F. E.	F	Fair digestion	Full digestion	Weak digestion	Pancreas felt normal	Patient came in with symptoms of an acute exacerbation which subsided. Cholecystectomy and choledochostomy 18 mos. previously
39205	M. C.	F	Fair digestion	Fair digestion	Poor digestion	symptoms of chronic pancreatitis now	

should be given at intervals after closure of the biliary fistula until the bile is free from the infecting organism.

Tests for Pancreatic Ferments.—(Chart II). It has been definitely demonstrated in this series that the material to be examined must be analyzed as promptly as possible. The specimens are useless if allowed to stand at room temperature for over an hour.

The technic used has been:

For Amylase: Place 5 c.c. of a 1 per cent. solution of starch in each of six test-tubes. Employ one tube as control.

Tubes	1	2	3	4	5	6
Juice	0	0.05	0.1	0.25	0.5	1.0

Incubate for thirty minutes at 37° Centigrade, then add two drops of decinormal iodine. Violet color disappears in digested tubes.

For Protease: Place 5 c.c. of 0.1 per cent. casein in 0.1 per cent. sodium carbonate solution in each of six tubes. Use same amounts of juice as above. Incubate for fifteen minutes at 37° Centigrade. Add same amount of dilute acetic acid to each tube. Precipitate appears in undigested tubes.

For Lipase: Place 1 c.c. of juice in each of two tubes. Boil one as a control. Add 1 c.c. of neutral ethyl butyrate and 10 c.c. of distilled water plus 1 c.c. of toluene. Incubate for twenty-four hours. Shake several times during the interval. Titrate with N/20 sodium hydroxide, using phenolphthalein as indicator.

Complete absence of all pancreatic ferments in an alkaline duodenal fluid containing bile is fairly definite proof of carcinoma of the pancreas. When bile is also absent in the duodenal contents common duct obstruction is definite.

The interpretation of decreased activity in any one or more of the three enzymes is difficult. If lipase is deficient, this finding should be taken seriously only if the stools show a high total fat content. Deficient pancreatic ferments in the duodenal contents, if proper technic has been followed, may indicate a chronic pancreatitis or advanced pancreatic lymphangitis in a case giving definite gall-stone or cholecystitis history.

The gross changes as noted at operation by palpation are not necessarily an indication of functional disturbance of the pancreas. That is, a pancreas may show marked lymphangitis without appreciable alteration in the pancreatic enzymes. This is fairly well illustrated in the comparison of operative findings with chemical findings in Chart II.

Comparison of the Results of MgSO₄ Instillation with the Lesions Found at Operation.—(Chart III). Taken with the history and physical signs, the duodenal tube findings bid fair to be of real service in localizing the lesion and determining the pathology before operation.

If, after MgSO₄ instillation there occurs a rapid flow of thick, dark green bile, the cystic duct may be considered patent and the walls of the gall-bladder contractile.

If this bile contains much mucus and numerous epithelial cells and leucocytes and intracellular bacteria, but few cholesterol crystals, a chronic cholecystitis without stones is the probable lesion.

Comparison of Pre-operative Duodenal Findings With Lesion Found at Operation

			Duodenal bile	"B" or gall-bladder bile	"C" or common duct bile	
47011	E. S.	F	Pale green, slow drip	No dark green bile. No "B" bile	Very turbid, steady flow. Greenish yellow	Cystic duct closed. Gall-bladder distended, adherent to colon. Many calculi
46382	E. M.	M	Pale green, clear	No "B" bile	Yellow, slightly turbid, steady flow	Cystic duct closed. Gall-bladder full of calculi and adherent to duodenum
46666	H. W.	F	Clear golden, thin	Marked change to thick greenish black, turbid	Greenish black to golden brown	Chronic cholecystitis, no calculi, cystic duct patent. Bile thick, blackish green
46732	P. B.	M	Greenish yellow, slow drip	No "B" bile	Greenish yellow, more rapid than before MgSO ₄	Test was made 6 weeks after cholecystectomy for purpose of testing pancreatic ferments
46823	A. H.	F	Yellowish, slow drip	No "B" bile	Yellowish, rapid flow	Gall-bladder tense. Cystic duct closed by small stones. Gall-bladder bile dark green
46318	A. L.	M	Clear, greenish, slow drip	No "B" bile	Clear greenish yellow, rapid flow	Gall-bladder thickened, adherent to duodenum. Cystic duct closed by calculi in gall-bladder
45660	K. R.	F	Yellow, slow drip	Gradual change to greenish black thick bile	Greenish bile, steady flow	Gall-bladder walls thickened, no calculi, cystic duct patent. Bile dark green, viscid
45289	M. P.	F	Yellow, slow drip	No "B" bile	Yellowish green, steady flow, turbid	Chronic cholecystitis, calculi in gall-bladder and cystic duct. Gall-bladder walls thick, adherent to duodenum
45289	M. I.	F	Yellow, slow drip	No "B" bile	Yellowish, slow	Test made 3 weeks after cholecystectomy
47346	W. S.	F	Yellow, slow	No "B" bile	Yellow, turbid	Gall-bladder shrunken, around several gall-stones, cystic duct closed
47188	L. G.	M	Greenish-yellow, turbid	No "B" bile	Greenish yellow, turbid	Fistula between gall-bladder and colon, incomplete obstruction of common duct with faces and stone
47203	A. W.	F	Lemon yellow, turbid, slow	No "B" bile	Lemon yellow, more rapid rate	Gall-bladder thick, adherent to duodenum, contained calculi. Pancreas very large. Common duct obstructed with calculi
47414	J. H.	M	Lemon yellow, steady drip	No "B" bile	Lemon yellow, steady drip	Recent acute cholecystitis. Walls and cystic duct edematous. Cystic duct closed by oedema. Two calculi
47544	M. H.	F	Yellow, clear colorless, alkaline fluid	No "B" bile	Yellow clear, steady flow	Thickened gall-bladder, adherent to colon, duodenum and anterior abdominal wall. Cholecystostomy 6 years previously
44186	J. A.	M	No bile in duodenum	No "B" bile	No response to MgSO ₄	Complete obstruction of common hepatic duct, result of carcinoma of function of right and left hepatic ducts
46813	J. K.	M	Pale yellow, very little bile in alkaline duodenal fluid	No "B" bile	Pale yellow fluid same as in before MgSO ₄	Chronic cholecystitis with calculi. Cystic duct closed. Common duct dilated, but no stones found
46813	J. K.	M	Golden yellow, steady drip	No "B" bile	Golden yellow after MgSO ₄	Duodenal intubation 1 month after cholecystectomy
47177	M. M.	F	Golden yellow, clear, intermittent	No "B" bile	Clear yellow. Same as before MgSO ₄	Gall-bladder thickened, adherent to pylorus, containing calculi. Cystic duct closed by calculus
47543	A. L.	F	Yellow, turbid, intermittent	No "B" bile	Yellow, turbid, no marked increase with MgSO ₄	Cholecystostomy 2 months previously. Cystic duct closed
48279	M. H.	F	Colorless, alkaline fluid containing pancreatic enzymes	No "B" bile	No effect with MgSO ₄ . No bile obtained	Congenital absence of gall-bladder. Common duct obstructed by 3 large calculi
47689	F. E.	F	Colorless, alkaline fluid containing pancreatic enzymes	No "B" bile	No effect with MgSO ₄	Stricture of common duct below stump of cystic duct causing complete obstruction
37542	F. G.	M	Golden yellow, slightly flocculent	Very abrupt change to thick greenish black bile after MgSO ₄	Return to golden brown, 10' after MgSO ₄	Exploratory 3 years previously showed normal gall-bladder with a cirrhotic pancreas. No symptoms of cholecystitis at present. Intubation was done to test pancreatic ferments
39040	J. H.	F	Golden yellow, turbid	No "B" bile	No change after MgSO ₄	Cholecystostomy 18 months previously. Patient diabetic still shows B. coli in bile culture from duodenum. Gall-bladder bile and tissue showed B. coli at operation
48570	E. D.	F	Golden yellow, clear viscid, alk. steady drip	No "B" bile	Golden yellow, clear, viscid alk. rapid flow	Acute cholecystitis with empyema, cystic duct closed. Calculi in gall-bladder. Pancreas not felt
48593	J. K.	M	Dark amber, turbid viscid, alk. slow drip	No "B" bile. green bile	Steady flow of brownish yellow, viscid, turbid	Gall-bladder filled with small stones, very little bile. Cystic duct closed by calculi
38214	C. B.	F	Golden yellow, clear viscid, alk. intermittent drip	No "B" bile	Golden yellow, clear, very viscid, intermittent flow	Gall-bladder filled with calculi and grayish mucus. Cystic duct blocked by a calculus, pancreas not enlarged
48773	A. G.	F	Light green, turbid, viscid, gritty particles present	Rush of darker green. May have been "B."	bile with gritty particles. "or "C"	Gall-bladder filled with large and small stones. Cystic duct patent. Common duct contained 15-20 calculi

DIAGNOSTIC USE OF DUODENAL TUBE

If, in addition to the last mentioned findings, cholesterin crystals microscopically are numerous and the bile feels gritty, calculi are also present.

If there is no "B" bile, but there is a history of biliary colic with marked tenderness in the gall-bladder region with or without palpable mass, the cystic duct is closed as a result of calculus or the œdema of an acute or subsiding cholecystitis.

"If there is no "B" bile, but the bile following $MgSO_4$ instillation contains many intracellular bacteria and leucocytes, an infection of the common duct as well as cholecystitis may be diagnosed.

If in a jaundiced case there is no bile in the duodenal contents showing pancreatic ferments, common duct obstruction above the papilla is surely present.

The duodenal tube is not an essential factor in the diagnosis of biliary and pancreatic cases, but it is fair to say that it gives information that permits of a more detailed and accurate diagnosis. The method can by no means take the place of a careful history analysis or thorough physical examination. All three should be considered in the diagnosis of this class of patients.

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ACUTE INTESTINAL OBSTRUCTION DUE TO STRANGULATION OF A LOOP OF SMALL INTESTINE BY MECKEL'S DIVERTICULUM

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MECKEL'S Diverticulum is a congenital anomaly caused by a persistence of the protruded portion of the small gut which is known as the intraabdominal portion of the vitelline duct and which is normally obliterated during the seventh week of fetal life. The vitelline duct connects the gut with the yolk sac at an early period of embryological development. It assumes most commonly the form of a finger-like protrusion ending, as a rule, blindly, from the terminal ileum, usually about one metre from the ileocecal junction. It most often springs from a point opposite the mesenteric border and generally has a smaller lumen than the adjacent coils of ileum. It is of fairly common occurrence, being found in about 2 per cent. of all subjects. Since the process of obliteration may be arrested at any stage, it naturally follows that there may be all degrees from the most frequently observed shallow pouch of one or two centimetres in depth, to the patent diverticulum which preserves its connection with the umbilicus and from which a small amount of mucus exudes, mixed at times with watery fecal material and constituting a persistent umbilical fistula.

A common variety is seen as a protrusion about the size and shape of a glove finger and possessing a rudimentary mesentery. Sometimes its distal portion is dilated so that it assumes a bulbous appearance.

There is usually a persistence of all the coats normally found in the small intestine and histologically the mucosa resembles that of the ileum.

There are a number of pathological conditions in which the diverticulum of Meckel becomes involved, although, considering its incidence in 1 per cent. of all subjects, it is not commonly the seat of trouble. Perhaps inflammatory processes are among the most frequent, and diverticulitis is attended by a symptomatology that renders its differentiation from appendicitis extremely difficult.

Intestinal obstruction due to Meckel's Diverticulum may be produced in several different ways:

(1) Volvulus may take place by rotation of the ileum about its mesenteric border caused by the lever action of the distended diverticulum.

(2) Intussusception has occurred due to the invagination of an inverted diverticulum into the ileum forming the starting-point for a progressing intussusception.

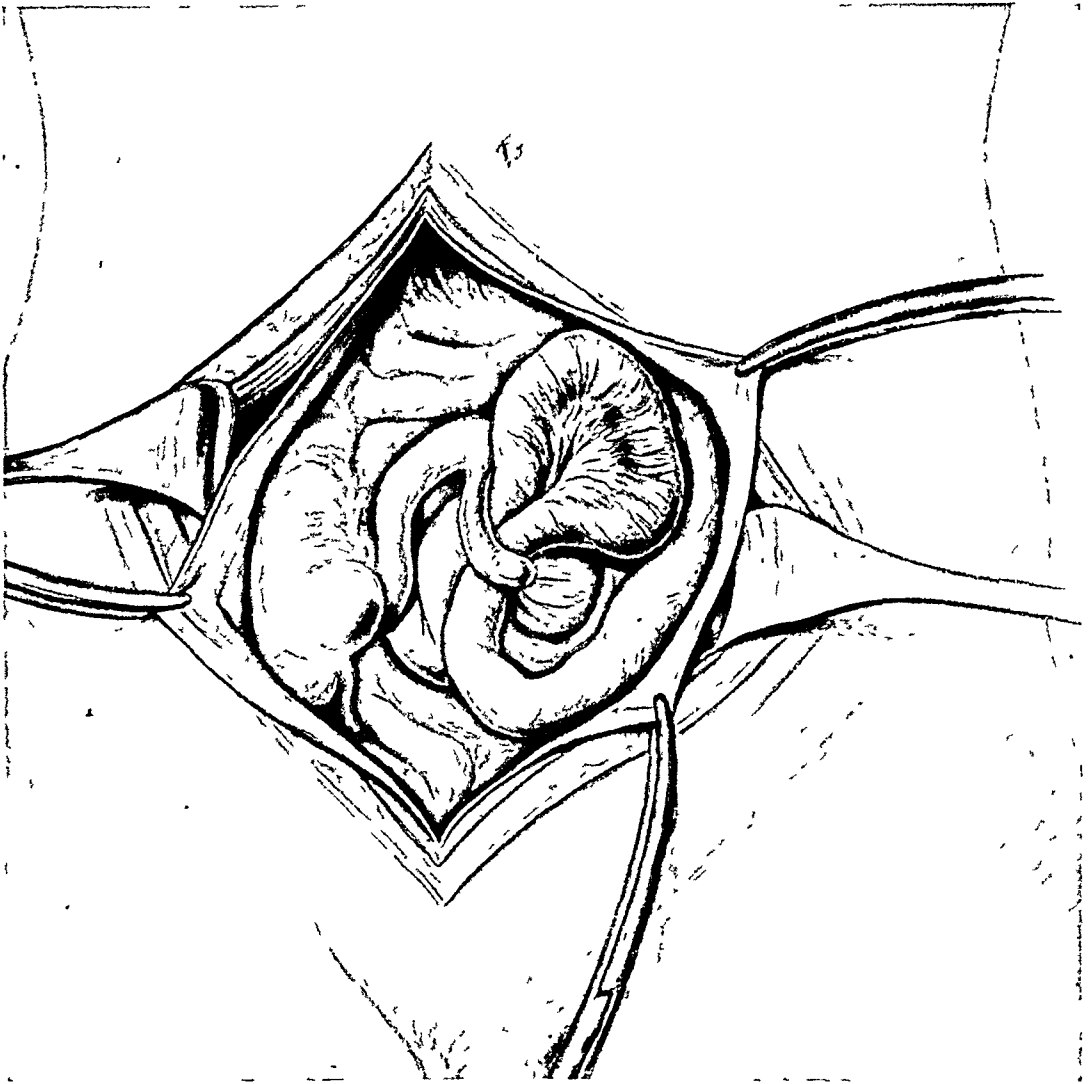


FIG. 1.—Loop of small intestine strangulated beneath a Meckel's Diverticulum.

(3) The commonest form of obstruction is caused by the diverticulum assuming the rôle of a band and causing strangulation of bowel loops caught between it and its attachment to the intestine and to the abdominal wall, generally at or near the umbilicus, or more rarely to the posterior parietal peritoneum near the root of the mesentery.

As the obstruction grows more acute the diverticulum as well as the obstructed coils of gut become gangrenous and perforation may occur.

REPORT OF A PERSONAL CASE.—E. P., male, aged twenty-six years, was admitted to the Mary McClellan Hospital of Cambridge, N. Y., on June 6, 1920. He was brought to the hospital by Dr. Charles H. Holmes, of Buskirk, at 7 P.M., with the following history:

The patient was a farmer, had always enjoyed excellent health; no previous abdominal symptoms. On Sunday, the day of admission, he had a good breakfast; shortly afterward he began to feel slight nausea and discomfort in the epigastrium. He stated he felt as if his abdomen had been struck. He went about doing his ordinary work after breakfast. One hour later began to have severe paroxysmal pains low down in the abdomen, which he characterized as "doubling-up" pains. These pains recurred at short intervals of a few minutes. The paroxysms continued to grow worse. He vomited for the first time one and one-half hours after his breakfast, and twice in addition, before operation. The bowels had not moved in the morning of the onset, and he had been somewhat constipated the night before. He stated that he had climbed inside of a chimney the day before; he had no fall and made no misstep, but was very much exhausted by the effort.

Previous History.—No similar previous attacks. Had had occasional vomiting attacks with pain after riding over rough roads. No history of indigestion. He does not remember any previous illness.

Physical Examination (on admission to the hospital).—Well-built young adult, apparently about twenty-five years of age, suffering from frequent attacks of paroxysmal abdominal pains, localized in no particular spot, centring, roughly speaking, about the umbilicus; slight tenderness in the right iliac fossa and region of McBurney's point, but no rigidity of the rectus muscle. Rectal examination negative; no mass palpable in any portion of the abdomen; no localized distention of coils of intestine in any portion of the abdomen. Heart and lungs, negative.

A provisional diagnosis of acute appendicitis had been made before he entered the hospital.

When I first saw him at 8 P.M. Sunday evening, eleven hours after the onset of his symptoms, physical examination showed the conditions just described; temperature, 98.6°; pulse, 72 (rectal temperature taken showed 99.2°). Blood examination: Whites, 12,400; polys, 90 per cent.; large lymphocytes, 2.5 per cent.; small lymphocytes, 7.5 per cent.

While we were unable to make a definite diagnosis of the condition, we felt certain that the very severe, steadily increasing paroxysmal pains

and particularly the general appearance of the patient—which was that of a person suffering from severe shock—made immediate exploration not only desirable but imperative. The patient was accordingly taken to the operating room and Doctor Coley operated upon him as soon as possible, with the assistance of Dr. Stanley T. Fortune, the resident surgeon. A vertical incision of the right rectus was made under ether anæsthesia. There was a large amount of clear fluid in the peritoneal cavity. At first nothing but deeply congested, distended coils of small intestine could be found. The appendix was normal. After careful search a loop of small intestine about one and one-half to two feet in length was found, greatly distended and dark in color, but not gangrenous, located in the bottom of the abdomen, somewhat more to the right side than to the left, a little above the pelvis. This loop of bowel was found to be strangulated by what seemed to be another loop of intestine, firmly attached and connected with a loop of small intestine above. The constriction was so tight that it was absolutely impossible to withdraw or free the strangulated loop. It took some time to recognize the exact anatomical condition, but it soon became apparent that we were dealing with a Meckel's Diverticulum, nearly of the same calibre as the normal small intestine, coming off at right angles from the lower portion of the ileum, about two feet from the ileocecal valve and extending downward to the root of the mesentery, and attached so firmly that it required a great deal of manipulation to dissect it off without tearing it. When the distal end was finally freed the strangulated loop slowly regained its color and, under hot towels, became apparently viable. The diverticulum was about five inches in length, had a rudimentary mesentery and tapered slightly in its distal end. It was of a deep, dark-red color, almost gangrenous in appearance, due to the great pressure of the distended coil beneath it, which was less dark than the diverticulum itself. The diverticulum was clamped off close to the wall of the intestine from which it had sprung, and the opening into the intestine, which was about one and one-half inches in diameter, was closed with two rows of fine chromic gut suture; the abdominal wound was closed without drainage.

The patient made an uninterrupted recovery, and has been in good health up to the present time.

Discussion.—Reginald Fitz's classical paper, "Acute Intestinal Obstruction," read before the Congress of American Physicians and Surgeons, in Washington, in September, 1888, represents the most complete discussion of the subject that had thus far appeared. It contained a critical analysis of 295 cases collected from the surgical literature, with careful elimination of all cases in which full data were lacking. These 295 cases are classified as follows: Strangulation, 101 cases; intussusception, 93 cases; abnormal contents, 44 cases; twists and knots, 42 cases; strictures and tumors, 15 cases.

Of the 101 cases of strangulation 63 were due to adhesions, 21 to vitelline remains, 6 to adherent appendix, 6 to mesenteric and omental slits and 3 to peritoneal pouches and openings, 1 to adherent tube and 1 to pedunculated tumor.

Seventy per cent. of the obstructions from strangulation occurred in males.

In 82 per cent. of all the cases of strangulation, pain was the first and most important symptom, usually sudden, severe and colicky, and most frequently starting in the region of the umbilicus. In 69 per cent. of the cases nausea and vomiting were associated with the pain.

Tympanitic distention of the abdomen occurred in slightly over half of the cases, most often after the first to the sixth day.

Slight rise of temperature, usually below 100° F., was noted in about one-half of the cases.

The position of the strangulating object was found in the right iliac fossa in 67 per cent. of the cases, and in the lower abdomen in 83 per cent.

In the cases treated medically death occurred in half of the cases from the second to the fourth days.

Fitz's paper brings out in a striking manner the great difference between the methods of treatment of intestinal obstruction in 1888 and the present time.

Operation was performed in 67 per cent. of the cases of strangulation, with 41 deaths, or a mortality of 61 per cent.

Of the 67 cases operated upon with 41 deaths, it is interesting to note that operation was performed on or after the third day in 39 of the cases, and in 32 on or after the fifth day. In other words, in 1888, early treatment of acute intestinal obstruction was practically always medical; in fact, Fitz himself states:

"In the light of the published experience of the past eight years, the medical treatment of acute obstruction is limited to the use of injections during the first three days, under sufficient degrees of pressure, within fixed limits, to determine the patency of the large intestine. If it proves impassable, the case is no longer medical, but surgical." In conclusion, Fitz states, "Acute intestinal obstruction is diagnosed by exclusion, the seat is fixed by injection. Its variety is determined by its seat, the age, antecedents and symptoms of the patient. Its treatment is surgical on or after the third day, if the symptoms are urgent and forced injections fail to relieve."

In strangulation by Meckel's Diverticulum I believe the most important diagnostic symptom is severe, colicky pain with frequently recurring paroxysms, non-localized, nausea and vomiting; complete absence of stools, and absence of tenderness and rigidity. Next in importance to the pain is the general appearance of the patient, which is more or less that of a person suffering from shock.

CASES OF STRANGULATION FROM MECKEL'S DIVERTICULUM REPORTED IN
RECENT LITERATURE

CASES I-II.—JAMES E. THOMPSON reported two cases of intestinal obstruction due to Meckel's Diverticulum before the meeting of the Southern Surgical Association in St. Louis in 1897. Case I was an acute strangulation of the ileum under a bridge formed by Meckel's Diverticulum, the symptoms lasting five days; operation; death. The patient was a young man twenty-nine years of age who, when first seen by Doctor Thompson, had been suffering from severe symptoms of intestinal obstruction for five days. The attack began with very severe abdominal pain. He had been treated by repeated doses of strong purgatives and enematas, without success. Temperature, 99°; pulse, 72; moderate distention. Immediate operation was advised, but refused until the following day. A loop of small intestine was found strangulated by a band in the right iliac fossa; this band proved to be a short, stumpy Meckel's Diverticulum, one and one-half inches long. The distention was so great that some of the coils had to be emptied of gas before the intestine could be replaced. The patient died of shock a few hours later.

The second case, while classed by Doctor Thompson as a case of intestinal obstruction due to Meckel's Diverticulum, is really a case of strangulated inguinal hernia, which had been reduced by prolonged taxis on the part of the patient himself. The taxis caused a rupture at the root of Meckel's Diverticulum, resulting in peritonitis, for which the operation was done at a late stage without avail. Hence, this case can hardly be classed as an obstruction due to strangulation by a Meckel's Diverticulum.

CASE III.—E. W. SYMPSON (*Lancet*, June 30, 1917, p. 998). The patient, a youth twenty-one years of age, was admitted to the Lincoln County Hospital on May 1, 1917, suffering from acute intestinal obstruction. Acute peritonitis two years previously. Two days before admission to the hospital he had an attack of sudden, acute pain over the whole abdomen, spasmodic in type and followed by persistent vomiting, which, within twelve hours, became definitely stercoraceous; there had been absolute constipation from the start. Temperature, 97°; pulse, 130; feeble. Provisional diagnosis of "strangulation by bands" was made. On operation a Meckel's Diverticulum was found about two feet above the ileocecal valve; it was about four inches long, adherent at its tip to the posterior abdominal wall and to the root of the mesentery opposite the second lumbar vertebra, and forming an aperture through which about two feet of ileum had become prolapsed and strangulated. The patient made an uninterrupted recovery and was discharged four weeks after operation.

CASE IV.—ROSCOE GRAHAM, in the *Journal of the Canadian Medical Association*, vol. 8, p. 966, November, 1918, reports four cases of intestinal obstruction due to Meckel's Diverticulum, three of which were operated upon by Dr. F. N. G. Starr.

The patient, a woman, married, aged forty-five years, was admitted to the Toronto General Hospital complaining of severe pain in the right iliac region, which had come on suddenly eight days before, and lasted for three days, accompanied by considerable vomiting. She had had more or less discomfort in this region ever since her first child was born, sixteen years ago. After the third day the pains became less severe, but left a dull soreness. Examination showed a temperature of 102°; pulse, 100; slight muscular rigidity on the right side and tenderness on palpation. Operation: evacuation of appendicular abscess and removal of organ. After doing well for three days, the patient became steadily worse, and the probable diagnosis of paralytic ileus was made; further operating was considered inadvisable. The patient died a week after operation.

Post-mortem examination showed, eighteen inches from the ileocecal valve, a volvulus of the ileum, produced by Meckel's Diverticulum, which had caused almost complete obstruction.

CASE V.—The second case, a female, was admitted to the Toronto General Hospital on October 9, 1916 (Dr. F. N. G. Starr). She complained of pelvic pains which had existed for the past two years. Abdominal examination showed nothing abnormal.

Vaginal examination revealed a cervical polyp and marked retroversion. Operation October 10th. Removal of polyp and appendix; correction of retroversion. Uneventful progress for first ten days; then pulse became more rapid and nausea set in. There was great distention. The pulse-rate reached 120. After further examination, a tentative diagnosis of obstruction of small intestine was made. On operation coils of the small intestine were found collapsed, and on following them up it was seen that they herniated under a Meckel's Diverticulum which was attached to the convex border of the ileum and to the superior aspect of its mesentery. The obstruction was relieved and the diverticulum amputated. The patient died twenty-four hours after operation.

CASE VI.—The third case, a woman, was admitted to the Toronto General Hospital on November 31, 1916, to the service of Doctor Starr. She complained of abdominal swelling, which she had noticed for the past few months and which was accompanied by vomiting and obstinate constipation. The appendix had been removed two years previously, and she has a ventral hernia. After examination the diagnosis of ovarian cyst was made and operation advised. It was found that the cyst arose from between the layers of the left broad ligament. On separating the adhesions, a mass of adherent intestine was found, from which ran a diverticulum which was attached to the cyst wall. It was deemed best to resect the bowel and an end-to-end anastomosis was made. Uninterrupted recovery.

CASE VII.—The fourth case, a boy, fourteen years of age, was admitted to the Toronto General Hospital (Doctor Starr) on December 3, 1915, complaining of abdominal pains. He had had two previous attacks, but the symptoms always disappeared after a few hours. This time they persisted. After careful examination, the tentative diagnosis of internal hernia was suggested, possibly caused by a Meckel's Diverticulum, despite the fact that the case clinically simulated appendicitis.

On operation a hernia was found under a Meckel's Diverticulum, very much the same as in the preceding case, except that a small loop of bowel was herniated, the rest having reduced itself spontaneously.

CASE VIII.—HABHEGGER (*Interstate Medical Journal*, September, 1916) publishes a case of intestinal obstruction due to Meckel's Diverticulum in a girl, eight years of age. She was taken sick on November 26, 1917, with severe abdominal pains, which recurred intermittently and were followed by vomiting, first, of mucous bile, later dark-brownish material; no bowel movements; no flatus. Examination, ten hours after the onset of the attack, showed the patient to be evidently desperately ill. Temperature, normal; pulse, soft and irregular; blood-pressure, 40. Facial expression natural. Abdomen uniformly distended; diffuse tenderness over the entire lower part of the abdomen; tympany everywhere; no muscular rigidity. The diagnosis of intestinal obstruction and paralytic ileus considered, but the clinical picture of collapse, apathy and stupor did not fit either condition. Operation was, of course, indicated, but not feasible for obvious reasons. The child grew progressively worse and all attempts to relieve the bowel were futile. She died twenty-three hours after the onset of the attack with all symptoms of collapse due to intense intoxication.

Autopsy revealed a large mass of reddish, bluish-black small intestine, greatly distended and filling the whole abdominal cavity; large intestine normal. No fluid in peritoneal cavity. Further examination of the small intestine showed it strangulated by a round band, which encircled the base of the mass of discolored bowel. The intestine involved was the jejunum at its junction of duodenum and ileum, within a few feet of the cæcum. The band was four inches in length and attached to ileum, about two feet above the ileocecal valve, and on its other extremity to the root of the mesentery of the jejunum near the spine. Through this opening, about four inches in diameter, about twelve feet of small intestine had prolapsed. Practically the entire small intestine was involved.

CASE IX.—R. A. BENNETT in *The Lancet* of June, 1919, publishes a case of intestinal obstruction due to Meckel's Diverticulum, in a girl, thirteen years of age. She was

admitted to the Torbay Hospital, Torquay, on November 21, 1918 (Dr. A. Spong) with a history of sudden abdominal pain, setting in four days previously, after a hearty meal. The pain was not intense nor localized. Vomiting soon followed and the patient had been more or less sick ever since. No bowel movement since the onset of the attack; no flatus. Temperature, 98.6° F.; pulse, 128; respiration, 24. The whole abdomen was rigid and tender, the pain being most pronounced on the left side, just above the umbilicus. A diagnosis of intestinal obstruction was made and the abdomen was opened at once. Distended, acutely congested small bowel presented, and when pushed aside revealed collapsed small intestine and colon. After further search, Meckel's Diverticulum was found; its proximal portion was a thin and fibrous cord, twisted many times on its axis; the distal part was a dilated pouch, filled with blood-clots and adherent to a tag from great omentum, also inflamed and twisted. The connection had formed an arch under which the lower four feet of ileum had become partially strangulated.

HOHLBECK (*Arch. f. klin. Chir.*, Bd. lxi, p. 1, 1900) reports three cases of intestinal occlusion due to Meckel's Diverticulum, observed at the City Hosp. of Riga (Dr. von Bergmann), with two deaths and one cure.

CASE X.—A young man, aged eighteen years; 29/7/94. There was an ileocecal invagination, about one-half foot in length. Drawn into the invagination there was a Meckel's Diverticulum the size of a walnut, which had undergone such changes as to render extirpation necessary. The diverticulum was not inverted *in toto*, but only its mucous lining.

July 7: No stool; no gases. Patient died in collapse the following day.

CASE XI.—Boy, aged four and one-half years. May 5, 1898: Diverticulum about six inches in length, situated 22 cm. above ileocecal valve and adherent with its blind end to an omental band. Resection of 27 cm. of small intestine together with diverticulum. Murphy's button. The diagnosis of occlusion due to Meckel's Diverticulum in this case was made only after examination in narcosis, when a tumor, the size of a small finger, was palpated to the right, below the umbilicus, the torsion of the intestine around its longitudinal axis resulting from the pull of the adherent diverticulum causing the occlusion.

CASE XII.—Woman, aged thirty-nine years; October 16, 19—. About 40 cm. above cæcum a loop of ileum is seen to be constricted by a band; further down, this is connected with a diverticulum 23 cm. long, of the shape of a cucumber, about 4 cm. at its upper end. The walls of the diverticulum are expanded to the maximum. Resection of a piece of intestine 80 cm. in length. Murphy's button with Lembert suture on top. Patient discharged cured November 10th.

Diverticulum incarcerations, according to Leichtenstern, are much more frequent in men than in women, his statistics, comprising 66 cases, showing 52 males and 14 females.

The prognosis of incarceration due to Meckel's Diverticulum is very bad. Boldt collected 55 cases with 15 laparotomies and only 3 cures; mortality of 80 per cent.

Bérard and Delore collected 32 cases of laparotomy for occlusion due to Meckel's Diverticulum, with 9 cures and 23 deaths—72 per cent. mortality.

Hohlbeck states that Kelynack's opinion, holding Meckel's Diverticulum to be a harmless formation, certainly seems remarkable. He found a Meckel's Diverticulum 18 times in 1446 cadavers, and in none of these was the cause of death in any way related to the diverticulum.

I believe that the mortality of acute intestinal obstruction from Meckel's Diverticulum should be greatly reduced if operation is done early, say within the first twelve hours, instead of after two to three days, as has been the case in most of the cases operated upon.

CASE XIII.—FERGUS (*Glasgow Medical Journal*, 1915, lxxxiv, p. 12). (No dates given.)

The patient, a young woman, aged nineteen years, was evidently acutely ill; temperature up, pulse rapid; obstinate constipation; pain and tenderness all over abdomen,

STRANGULATION BY MECKEL'S DIVERTICULUM

spasmodic in character; rigidity of muscles; vomiting; considerable distention. Diagnosis of intestinal obstruction made; operation advised; removed by ambulance to one of the nurses' homes, where she was operated upon by Doctor Dalziel. The small intestine was found intensely congested, of a dull reddish-purple color, and greatly distended. The obstruction was found to be due to a Meckel's Diverticulum, about eight inches in length and of a calibre nearly equal to that of the small intestine. It had firmly strangled the small intestine, the distal end of the diverticulum being bound down by fresh adhesions. The diverticulum was freed, but in view of the congested condition of the small intestine above the obstruction, it was not considered advisable to do more than relieve the obstruction and free the diverticulum, which was returned into the abdomen, and the wound closed. The patient made a good recovery. The diverticulum was removed in a second operation a few months later. She has been in good health since.

CASE XIV.—DRYBROUGH-SMITH (*Lancet*, London, 1917, ii, p. 24). June 30, 1917.

Operation done on an infant, seven days old. The child had a patent Meckel's Diverticulum at birth, protruding from the umbilical cord just beyond its attachment to the skin. The bowel acted through this opening as well as by the natural passage. On the fifth day after birth, the child began to vomit and gradually intestinal obstruction became complete. On opening the abdomen, it was seen that the ileum had invaginated itself into Meckel's Diverticulum, dragging with it the mesentery. Result not stated.

CASE XV.—W. F. PEARCE.—Perforation of Meckel's Diverticulum and accompanying appendicitis (*U. S. Nav. M. Bull.*, Washington, 1919, xiii, p. 346).

Patient male, U. S. N. Res. Corps, brought to the hospital on December 25, 1918. For the last two to three days slight discomfort in abdomen. In the morning of the 25th severe pain in the region of the umbilicus, later shifting to Meckel's Diverticulum; vomited several times. Temperature, 98.6° F.; pulse, 120; pinched expression of face; abdomen very sensitive, particularly over McBurney's point; marked muscular rigidity. Immediate operation. A large amount of greenish-gray fluid encountered. Appendix inflamed, sharply kinked, in beginning gangrene, but not perforated; removed. Further careful search disclosed Meckel's Diverticulum, definitely inflamed and with a perforation about midway between tip and base; removed; stump inverted; two drains placed and incision closed in layers. Eight days after operation, temperature normal and drainage ceased on tenth day. The patient was up and about and wound closed at time of report.

The diverticulum in this case was 4 cm. in length, 2.5 cm. at top and 3 cm. at base.

CASE XVI.—E. A. WILKINS (*Med. Press*, London, 1919, cvii, p. 10). Male, aged twenty-two years; farmer. Sudden onset of severe, colicky pains in umbilical region; moderate vomiting; slight abdominal tenderness; no rigidity, nor distention. Pulse full and strong; temperature normal; face of good color. Intestinal obstruction considered, but thought unlikely. Turpentine enemas gave relief. Not called to see patient again till next day, 11 A.M. Then pains very severe; abdomen full; rigidity; great tenderness. Temperature, 101°; pulse slightly above normal, but strong. No vomiting since. Immediate removal to hospital; operation done two hours later by H. T. Dawson. A large tumor became evident under anæsthesia in mid-abdomen. On incision, black blood ran out and two large coils of black small intestine presented; a constricting band was felt across the root of the coils, which gave way under the finger and was not seen. No normal viscera seen; everything black; very little distention; wound closed. Severe pain, tenderness and rigidity continued for four days, requiring morphine; enemas failed to give relief; no vomiting. Pulse continued good and but little above normal until a day before death.

Post-mortem showed a perforation in the strangulated bowel, which had not recovered. A Meckel's Diverticulum, four inches long, three-fourths inch wide at base and tapering to a point, was found, the end of which was rough and evidently had been adherent. Fully four feet of bowel had been strangulated.

Wilkins says that this case shows that severe strangulation can occur without distressing vomiting and with a good pulse.

HERTZLER and GIBSON, of Kansas City, Mo. (*American Journal of Medical Sciences*, Philadelphia and New York, 1913, cxlvi, p. 364), in addition to reporting a personal case of invagination of Meckel's Diverticulum, associated with intussusception, have made a careful study of the recorded cases, and append brief histories of forty-one cases of invagination of Meckel's Diverticulum, associated with intussusception, in which sufficient data were obtainable to permit a judgment of the anatomical character of the lesion. All other incompletely reported cases are omitted.

In this series the age of the patients varies from 7 months to 39 years, the average being 13 years; 20, or 49 per cent., of the cases were under 10 years of age; 10 between 10 and 20 years.

The sex is given in 38 cases, 31 being males, 7 females.

In 17 of the 41 cases a history of previous attacks is definitely given. In 3 a single attack is mentioned; in 9 repeated attacks. Vomiting was recorded present in 24 cases, and in character was usually dark green or yellowish. The authors state that vomiting, compared to many types of intestinal obstruction, is characterized by its moderate intensity.

Of the cases in which resection was done, in so far as definite information is available, 13 died, and 9 recovered. Five of these cases came to operation from the sixth to the eighth day after the onset of the symptoms, indicating a subacute process. Of those in which reduction was feasible, requiring the removal of the diverticulum only, 9 recovered and 4 died. Their personal case was a youth, nineteen years of age. Two years before, attack of abdominal pains which he ascribed to eating raisins. The attending physician found a tumor immediately below the umbilicus, which he supposed to be a mass of raisins. He manipulated it with his fingers in order to break up the lump. The symptoms subsided and the patient had no trouble until December 18, 1912, when he became chilly and nauseated; better after two days; then, after a hearty breakfast, severe pain, followed by vomiting. The pains increased and morphine was administered; enemas were also given, but the symptoms continued. A tumor was palpated to the right of the median line. At last the patient was brought to the Halsted Hospital, with the diagnosis of intestinal obstruction. Examination showed the abdomen but slightly sensitive; no rigidity; moderate distention. Of course, it must be remembered that morphine had been given. Pulse, 144; temperature, 97°; respiration, 24. On opening the abdomen, straw-colored fluid escaped; the intestinal coils were injected and greatly distended; no paralysis. The ileocecal portion of the intestine was found lying over the kidney, presenting a tumor, which was seen to be an intussusception through the ileocecal valve, about twelve inches long, with a distinct tumor at its upper extremity. This was found to be an inverted Meckel's Diverticulum with a thickened apex about two and one-half inches long. The diverticulum was replaced; the mass in its apex was about the size of a walnut. Diverticulum was clamped just above the solid mass and mattress sutures passed on the ileal side of the clamp; latter removed and gut severed. Inversion of end into lumen of gut; cæcum replaced and loop of ileum containing stump of diverticulum pulled over above and distal to cæcum. During first days there was profuse drainage, which gradually reduced and drains were removed. (No data as to further history.)

As regards the frequency of Meckel's Diverticulum, statistics vary greatly. Its frequency, based upon autopsy reports, is given as 1 to 2 per cent. In 18,000 autopsy examinations of subjects who died of other trouble, fifteen cases of Meckel's Diverticulum were found, making it less than 1 per cent.

The interval of time elapsing between the first symptom and the operation varied between two to eight days. In our own case the interval

was less than twelve hours, which is the shortest period of time that we have been able to find in any of the recorded cases.

As regards the age of the patient in the cases which we have been able to collect, the youngest was four and one-half years old, and the oldest forty-five years; six occurred between the ages of fifteen to twenty-five years.

Balfour, in a review of 10,000 successive operations performed at the Mayo Clinic from 1907 to 1910 (*Collected Papers of St. Mary's Hospital*, 1910), reports fifteen cases of Meckel's Diverticulum. Of course, this does not give an accurate idea of the frequency of the anomaly for the reason that in comparatively few cases was there a necessity for a systematic search of the entire intestine. In only five of these cases had the diverticulum given rise to symptoms and only one of the five was operated upon for acute intestinal obstruction due to adhesions about an inflamed diverticulum. One was operated upon for a chronic obstruction of the cæcum and appendix which had slipped through a loop formed by a long, cord-like Meckel's Diverticulum, nine inches in length. In another case the operation was done for a discharging navel in a child two years of age. It was due to a Meckel's Diverticulum in connection with the ileum, and extended to the umbilicus.

The only case which was operated upon for acute obstruction was a male of five years. In this case there was a large diverticulum extending from the ileum to the umbilicus. It was necessary to do a lateral anastomosis between the loops of the ileum above and below the constricting point. Doctor Finney in his recent exhaustive paper on three hundred cases of acute intestinal obstruction observed at the Johns Hopkins Hospital over a long period of years, states that there was not a single case of acute obstruction due to Meckel's Diverticulum.

CHRONIC DUODENAL OBSTRUCTION WITH DUODENO-JEJUNOSTOMY AS A METHOD OF TREATMENT*

REPORT OF FORTY-ONE OPERATIONS

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IN my paper on this subject published in 1918, the belief was stated that the condition is common and that the diagnosis can often be made from the history and physical examination.

The object of this communication is to further emphasize the importance of the condition, to review the literature of the subject, to summarize our present knowledge concerning it, to present in greater detail the technic of duodeno-jejunostomy as a method of treatment and to report a further series of cases in which the procedure has been successful. In order to give a clear conception of the condition I have quoted freely from my previous paper on this topic.

The first record found in the literature is an article in Latin written by Boernerus¹ in 1752, in which he refers to the work of Celsus and Sylvester and describes the symptoms in a case of chronic obstruction.

"The patient was a man somewhat over fifty years of age, who appeared a skeleton. In the left hypochondrium was to be seen an oblong tumor, resisting but soft, easily movable both above and below, extending from the diaphragm down to the pubes. The appetite was nil, and the bowels were persistently obstructed so that it was only after eight days' use of aperients and enemata that a few indurated scybalæ were brought forth. There was nausea with inclination to vomit, occasionally even vomiting itself.

About eight weeks later he died. On the day following his death an autopsy was made. When the skin and abdominal muscles had been incised and dissected, there was not a trace of the peritoneum, the omentum, or the mesentery discernible. The canal of the intestines was confused chaos. But in the left hypochondrium, from the diaphragm quite to the pubes, was an oblong membranous sac, dilated and filled with flatus, occupying the whole region. It was the stomach dislocated from its proper site, passing below the umbilicus. Proceeding with the search, in the duodenum was found a solid and wrinkled constriction, exceeding the thumb in breadth, and so constricted that it was impossible to force through it even the most dilute fluids. The liver was of normal size but friable. Of the gall-bladder there was no distinct trace—there was marked hardening of the spleen."—*Boernerus, Fredericus, De Tabæ sicca lethale*, 1752. Condensed from the translation in full by Dr. J. W. Brannan.

In 1820 Yeats² described toxic symptoms which he attributed to compression of the duodenum by the transverse colon, and noted the close relation between the hepatic flexure and the lower part of the descending duodenum.

In 1829 Guyot³ reported a case of congenital contraction, and was followed by a number of other authors.

* Read before the Bellevue Alumni Society, February 2, 1921.

CHRONIC DUODENAL OBSTRUCTION

The first report appearing in the American literature is that of Anderson⁴ in 1848.

Von Rokitsky, in 1849,⁵ suggested that acute dilatation of the stomach is due to compression of the duodenum by the root of the mesentery.

Fagge⁶ described the symptoms of acute dilatation of the stomach in 1873 and reported the autopsy findings in what was apparently a case of duodenal obstruction with perforation.

In 1889,⁷ Glenard suggested that the traction from dilatation of the stomach causes a narrowing at the duodeno-jejunal boundary. He held that chronic duodenal obstruction is not uncommon.

Albrecht⁸ reported two cases of possible chronic obstruction in 1899, and noted the flattening of the duodenum between the spine and superior mesenteric artery. By attaching small weights to the mesenteric vessels he demonstrated that considerable water pressure is necessary to force fluid through the constricted duodenum.

In 1900, Robinson⁹ reported clinical observations and autopsy findings in cases of duodenal obstruction and showed a clear understanding of the relation it bore to compression by the superior mesenteric vessels. He was convinced that gastroduodenal dilatation is the indirect cause of many deaths in persons above forty years of age. His work is original and was the most comprehensive presentation of the subject up to that date.

In the same year Petit¹⁰ reported a case of acute mesenteric ileus cured by suturing the jejunum to the transverse mesocolon.

In 1905, Ochsner¹¹ described a sphincter muscle in the duodenum below the ampulla of Vater, to the action of which he attributes much of the duodenal pathology.

Boothby¹² (1907) questions the accuracy of his

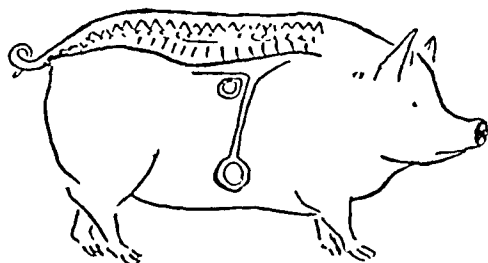


FIG. 1c.—The horizontal animal with ideal digestion. The root of the mesentery does not compress the duodenum.

(Reproduced from Codman's paper with permission of the author.)

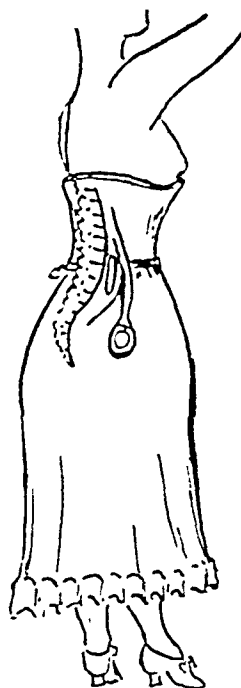


FIG. 2.—In vertical woman the duodenum is compressed by the mesenteric root.

observations, believing that the so-called sphincter muscle is merely a thickening of the muscle coat.

In 1905, Zade¹³ discussed post-operative gastromesenteric ileus. He is convinced that dilatation of the stomach is the most important etiological factor. If surgical intervention is necessary, he recommends jejunostomy.

Conner¹⁴ in 1906 reviewed the literature and described the symptoms and pathology of acute dilatation of the stomach and its relation to obstruction of the duodenum. He demonstrated on the cadaver that traction on the mesentery in the direction of axis of pelvis may obstruct the duodenum. He states that the presence of the small intestine in the pelvis seems to be a *sine quâ non* to the production of mesenteric occlusion of the duodenum. The mesentery must not be long enough, however, to allow the intestines to rest on the pelvic floor. Of the clinical manifestations of chronic obstruction, he says, nothing is known.

Bloodgood in 1907,¹⁵ and again in 1912,¹⁶ wrote on this topic. He reported cases of chronic obstruction cured by resection of the cæcum and ascending colon.

In 1908, Codman¹⁷ presented a masterly résumé of the subject. It is his contention

that the transverse portion of the duodenum is more or less compressed by the root of the mesentery. Anatomical deviations from the normal or certain pathological conditions may increase this pressure to a varying extent, up to the point of occlusion of the gut. When this pressure reaches a degree great enough to give more resistance to the muscular efforts of the duodenum than the closed pylorus, the condition becomes of pathological



FIG. 3.—Duodenal obstruction at the junction of the first and second portions. Gastropnoxis caused angulation at that point

significance. The duodenal secretions are thus brought in contact with mucous membranes unfitted physiologically to withstand their corrosive action. Obstruction favors stasis in the duodenum and bacterial invasion of the tissues. Acceptance of the above propositions will alter the present conception of such conditions as hyperchlorhydria, nervous dyspepsia, duodenal and gastric ulcer, pancreatitis, cholelithiasis, persistent vomiting after laparotomy and in pregnancy.

CHRONIC DUODENAL OBSTRUCTION

Laffer¹⁸ reviewed the literature of acute gastromesenteric ileus in 1908. The student will find in his bibliography and in that of Conner's the more important articles dealing with acute obstruction. The study of these will add to the understanding of the chronic condition.

Lane,^{19, 20} Spencer and Graham,²¹ Melchior,²² Harris,²³ Benjamin,²⁴ Corwin,²⁵ Barber,²⁶ Vanderhoof²⁷ and Kellogg,^{28, 29} have published papers dealing with the chronic phases of the problem.

During 1920, Freeman,³⁰ Crouse,^{31, 32} and Quain³³ discussed the operative treatment.

Several interesting anatomical studies have been published which add to a better comprehension of the subject. I refer particularly to an article by Sir Frederick Treeves³⁴ in 1885, describing the developmental changes which take place in the primary digestive

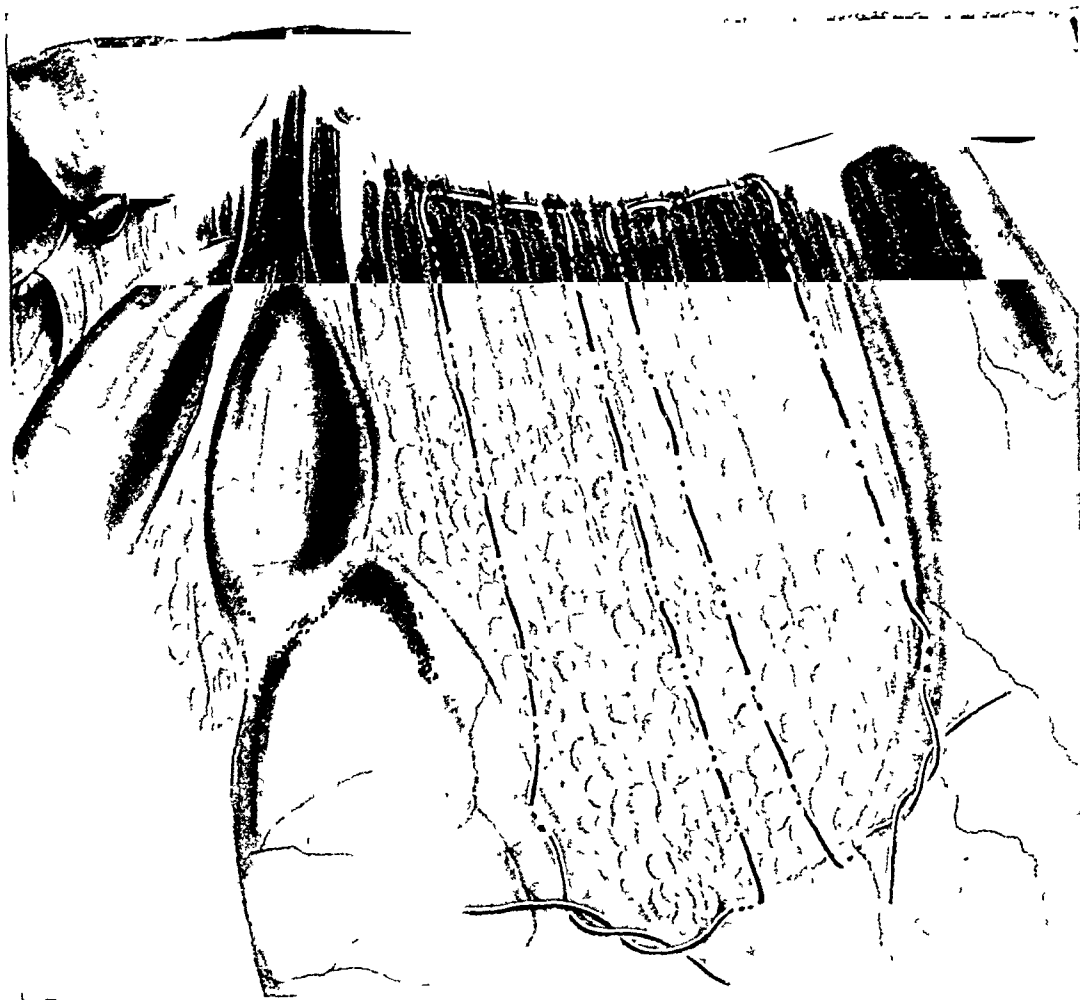


FIG. 4.—Duodenal obstruction due to gastropnoxis. Corrected by taking a reef in the gastro-hepatic omentum, (Beyer's operation).

tube, and to that of Lewis Dwight,³⁵ presented in 1897, demonstrating various types of duodenum by the use of wax casts. He recognizes the U. V. ring, C. triangular and S. shapes. His casts show a constriction at the termination of the first, second and third portions, and in the latter a groove posteriorly from vertebral pressure and a notch above where it is crossed by the superior mesenteric vessels.

In 1903, Fawcett and Blatchford³⁶ studied the relation of the lower border of the transverse duodenum to the vertebral column and reported as follows:

Total number of autopsies	337
Male	190
Female	144

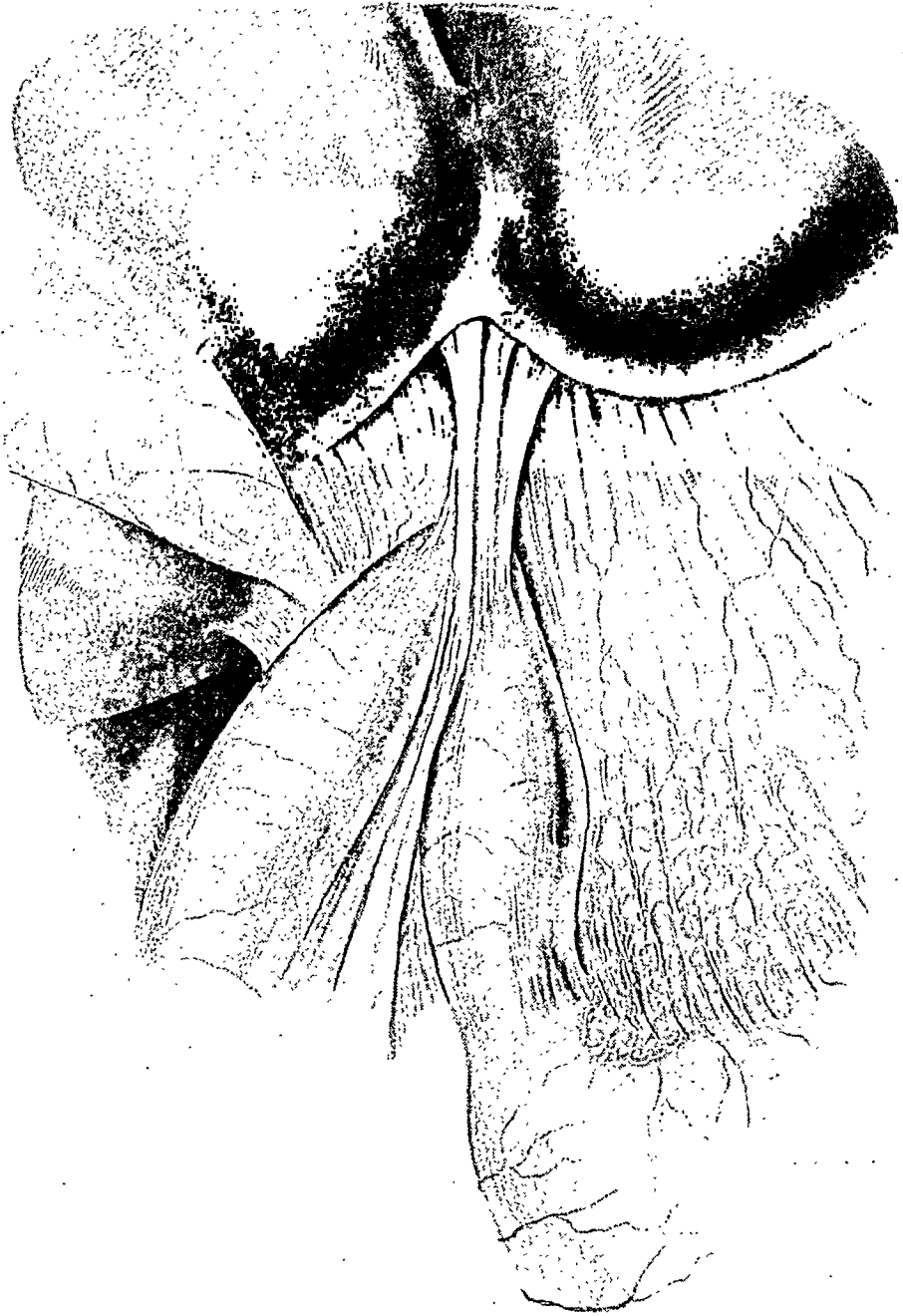


FIG. 5.—Duodenal obstruction at the termination of the first portion caused by a band of adhesions crossing in front and drawing it up under the liver, producing acute angulation. Treatment consisted of dividing adhesions and sliding the duodenum downward so as to correct the angulation.

CHRONIC DUODENAL OBSTRUCTION

Relation of lower border to vertebra:

Second lumbar	30 or 8.9	per cent.
Disk	44 or 10.	per cent.
Third lumbar	162 or 48.	per cent.
Disk	44 or 13.	per cent.
Fourth lumbar	46 or 13.6	per cent.
Disk	4 or 1.8	per cent.
Fifth lumbar	2 or .59	per cent.
Disk	1 or .29	per cent.
Did not cross vertebral column	4 or 1.8	per cent.



FIG. 6 —Duodenal obstruction above the ampulla of Vater resulting from a healed pyloric ulcer. A heavy band extends from the gall-bladder across the duodenum to the pylorus. The gall-bladder is drawn back to show the constricting band, but at operation it was found to be adherent to the duodenum and pylorus. The treatment consisted of cholecystectomy and dividing adhesions.

Jonnesco,³⁷ 1889, wrote on the topographic anatomy of the duodenum.

Armstrong,³⁸ Freeman³⁹ and Aitken³⁹ have described a type of duodenum having a mesentery passing down to the pelvic brim and ascending to the transverse mesocolon.

MECHANISM OF DUODENAL OBSTRUCTION

In studying the mechanism of duodenal obstruction, the following predisposing causes should be considered. In the developmental changes,



FIG. 7.—Duodenal obstruction involving the first and upper half of second portions, caused by an enveloping membrane. The two portions are held closely approximated. Treatment consisted of duodeno-duodenostomy.

which take place in the primary digestive tube during the process of rotation and the progress of the cæcum to the right iliac fossa, the duodenum is left in a position favoring compression between the vertebral column and the mesenteric root. This congenital disadvantage will be increased by faulty development of the lower thoracic region, lordosis of the lumbar spine, relaxed abdominal walls, a loosely attached cæcum and ascending colon, long mesentery and mesocolon.

CHRONIC DUODENAL OBSTRUCTION

The obstruction may involve (*a*) the first portion only, (*b*) the first and second portions, (*c*) the entire duodenum. (See Figs. 1 to 15.)

When the obstruction is limited to the first portion, it is usual to find one of the following causes: Duodenal ulcer, angulation caused by adhesions between the first and second portions, mesenteric bands drawing the duodenum up under the liver, or gastropnoxis, the duodenum remaining fixed.

When the second portion is involved, we find adhesions extending



FIG. 8.—Duodeno-duodenostomy performed for relief of duodenal obstruction caused by extensive adhesions between the first and second portions.

from the gall-bladder or hepatic flexure of colon, adhesions between the second and third portions, or angulation at the junction of the second and third portions caused by the downward drag of a prolapsed hepatic flexure.

In obstruction of the entire duodenum, the direct cause is usually the compression of the duodenum between the vertebral column and the superior mesenteric vessels.

Bloodgood¹⁵ has pointed out that this is favored by a redundant cæcum displaced into the pelvis with a short mesentery at the portion of the ileum near the cæcum, and the writer has called attention to

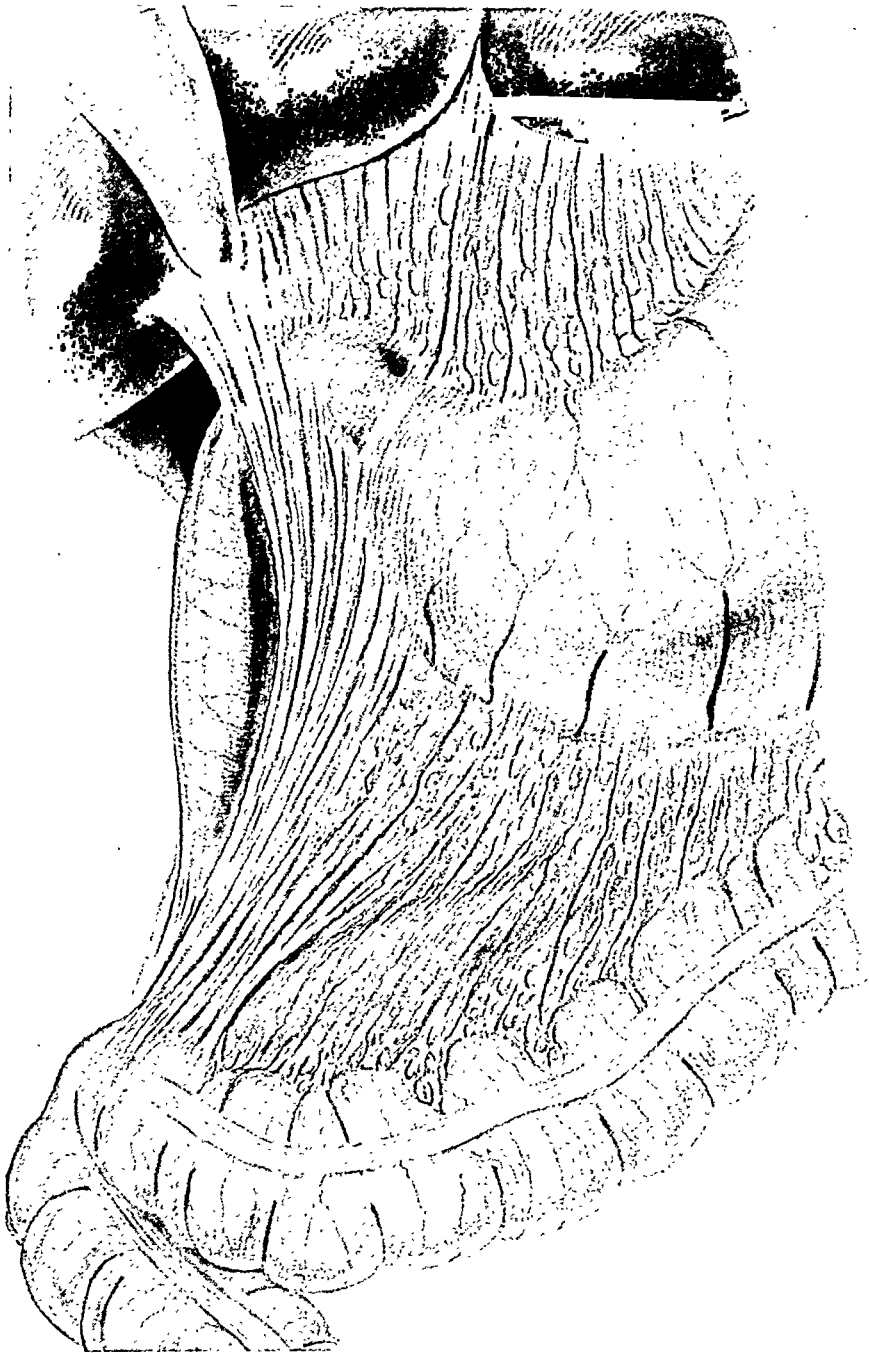


FIG. 9.—Duodenal obstruction at two points. Adhesions extend from the gall-bladder across the termination of the first and second portions of the duodenum to the prolapsed hepatic flexure of the colon. Treatment consisted of dividing adhesions, suturing cæcum and ascending colon to posterior peritoneum and restoring the hepatic flexure.

ptosis of the hepatic flexure, permitting a direct pull upon the mesenteric root.

Other causes which have been described are an annular-shaped pancreas surrounding the duodenum, gall-stones impacted in the duodenum, angioma of the jejunum, constriction of mesenteric opening through which the duodenum passes, angulation at the duodeno-jejunal junction,

CHRONIC DUODENAL OBSTRUCTION

gastroptosis, disease of the pancreas, ulcer, cancer, adhesions involving the jejunum, gastroenterostomy and prolonged dorsal decubitus.

The physical signs of obstruction above the ampulla of Vater are those of pyloric obstruction, the stomach being dilated or prolapsed and emptying slowly, sometimes with visible peristalsis.

In obstruction of the second and third portions, as pointed out by Hayes,⁴⁰ the dilated duodenum may be shown by a tympanitic area be-

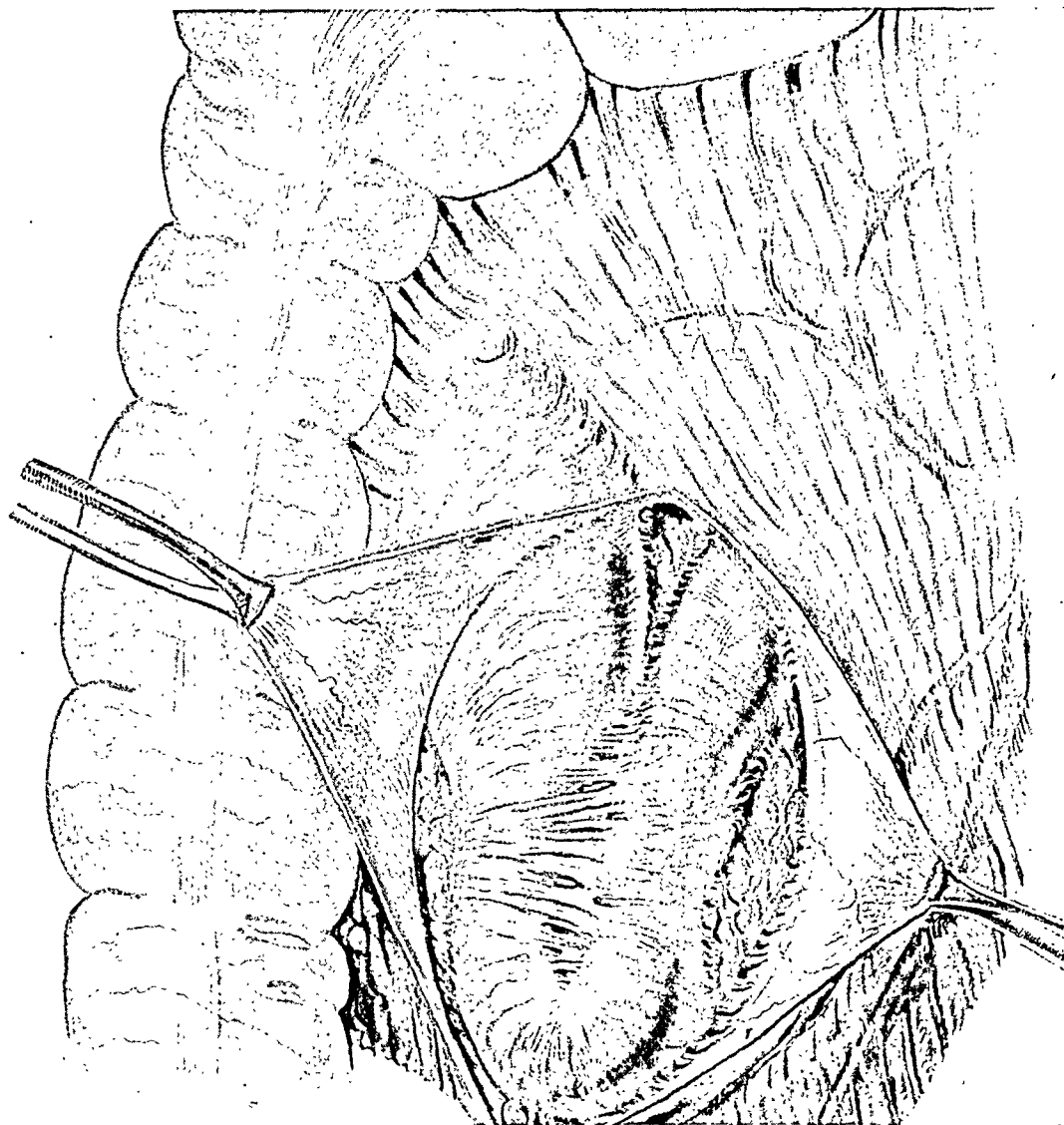


FIG. 10.—Duodenal obstruction due to adhesions between the second and third portions. Treatment consisted of dividing adhesions and duodeno-jejunostomy.

hind the right rectus muscle, to the right of, or posterior to, the pylorus and lying between the liver above and transverse colon below. Percussion should be employed with sufficient pressure to diminish the gastric and colonic tympany. Pressure upward and backward beneath the transverse colon permits the duodenum to empty itself, the gas can be felt or heard escaping into the jejunum, after which the percussion note becomes relatively dull, or there is a marked diminution in the size of the tympanitic area.

Limited experience with the duodenal splashing sound, described by Cash,⁴¹ leads to the belief that it is a physical sign of value.

The X-ray study of obstruction of the first portion commonly makes the diagnosis clear, but in obstruction of the entire duodenum a negative report is not infrequent, partly due to the fact that the predisposing cause may not be constantly operating, or that duodenal peristalsis may have been stimulated by a preliminary cathartic, but also because a special technic is often required. Quimby⁴² states that "by filling the duodenum and pressing upward on the stomach, then rotating the patient to the left, the amount of retention in the duodenum should show the degree of obstruction."



FIG. 11.—Duodenal obstruction involving the third portion. (This picture is borrowed from Bloodgood's paper¹⁶, and is published with permission of the author.)

SYMPTOMS

For a clearer understanding, the cases may be grouped in accordance with the anatomical and symptomatic variations.

Anatomical Grouping.—

First. The asthenic duodenum: The symptoms are latent or toxic. X-ray examinations may show delay and puddling of bismuth in the duodenum, with sluggish peristalsis and slight or no dilatation.

Second. Duodenal obstruction with incompetent pylorus. Bile regurgitates easily into the stomach, dilatation is moderate or absent.

Third. Obstruction with hypertrophy (the writhing duodenum). The duodenum is elongated and its walls are thickened. Under the fluoroscope it is seen to labor over its contents. The pylorus functions and little or no bile regurgitates; cramp-like pains are the predominant symptom.

Fourth. Dilated duodenum. The area of duodenal tympany is increased. Pain is usually present, either steady and dull, or cramp-like. This is the type most frequently recognized by the röntgenologist.

Symptomatic Grouping.—First, latent; second, toxic; third, mechanical; fourth, toxic and mechanical.

CHRONIC DUODENAL OBSTRUCTION

Latent obstruction may exist without diagnostic symptoms, the condition being recognized at operation or by X-ray examination.

THE TOXIC SYMPTOMS

Laboratory studies of duodenal toxicity, after ligation of the jejunum, have been made by Maury,⁴³ McLean and Andries,⁴⁴ Whipple, Stein and Bernheim.⁴⁵ Experimental animals die in a few days with weak pulse, low blood-pressure, subnormal temperature and diminished secretion of urine. The last authors have shown that the cause of death is a chemical and not a bacterial poison.

In human beings we find these symptoms, together with the characteristic vomiting or regurgitation, in acute gastromesenteric ileus, in certain cases of vicious circle after gastroenterostomy, and in the terminal stages of chronic duodenal obstruction.

The usual toxic symptoms are less severe, however, such as vomiting, headache, neuralgia, mental and physical depression, disturbed heart action, cold extremities, hyperæsthesia, paræsthesia, skin eruptions and neurasthenia.

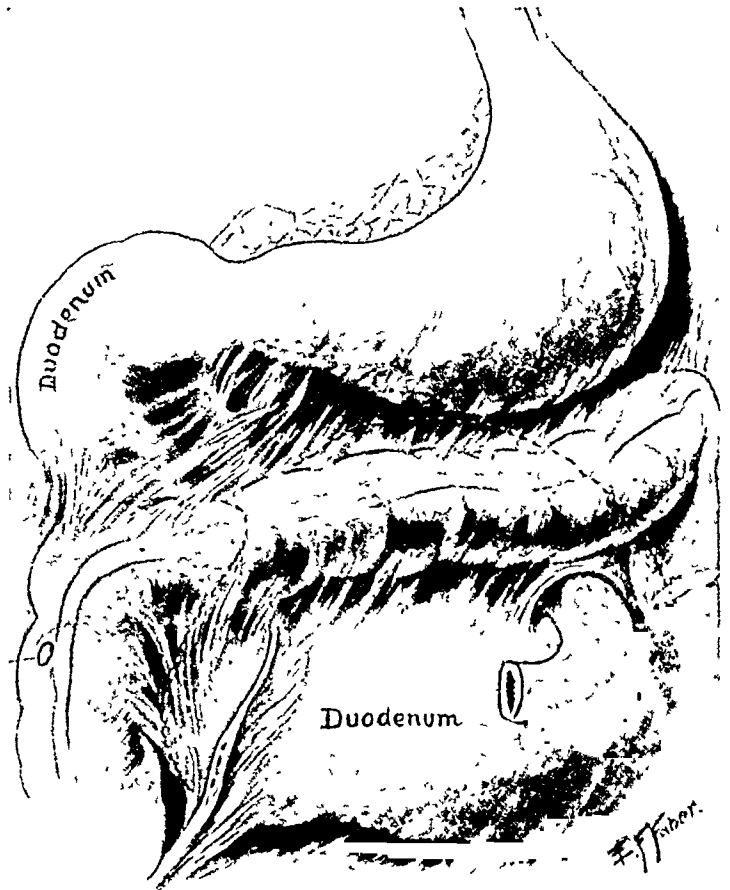


FIG. 12.—Duodenal obstruction involving the third portion. (Borrowed from Deaver's paper⁶¹ and published with the permission of the author.) This patient had a duodenal ulcer which perforated three times and ultimately caused death.

THE MECHANICAL SYMPTOMS

These vary with the mechanism of the attacks. When obstruction involves the first portion only, the symptoms are those of partial pyloric obstruction. Harris²³ has made a study of this group and states that it is a chronic condition with remissions. His patients complained of distress or pressure in the epigastrium sometimes becoming a sharp pain, recurring two or three hours after meals and relieved by food. With this there is epigastric tenderness and excessive secretion of hydrochloric acid. If compression takes place in the region of the ampulla of Vater, we may have papillary stenosis, as pointed out by Anders⁴⁶ and Campiche,⁴⁷ with deep chronic jaundice, acholic stools,

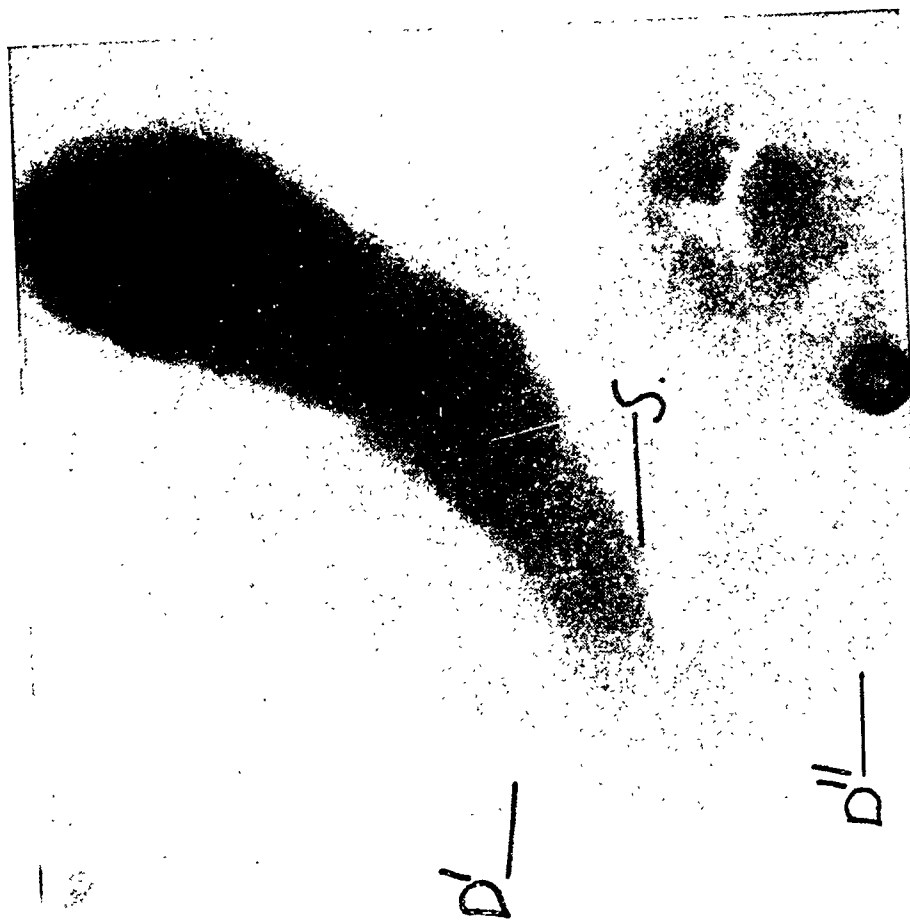


FIG. 13.—Mrs. W. No. 4. Dilatation of entire duodenum cured by duodeno-jejunostomy.

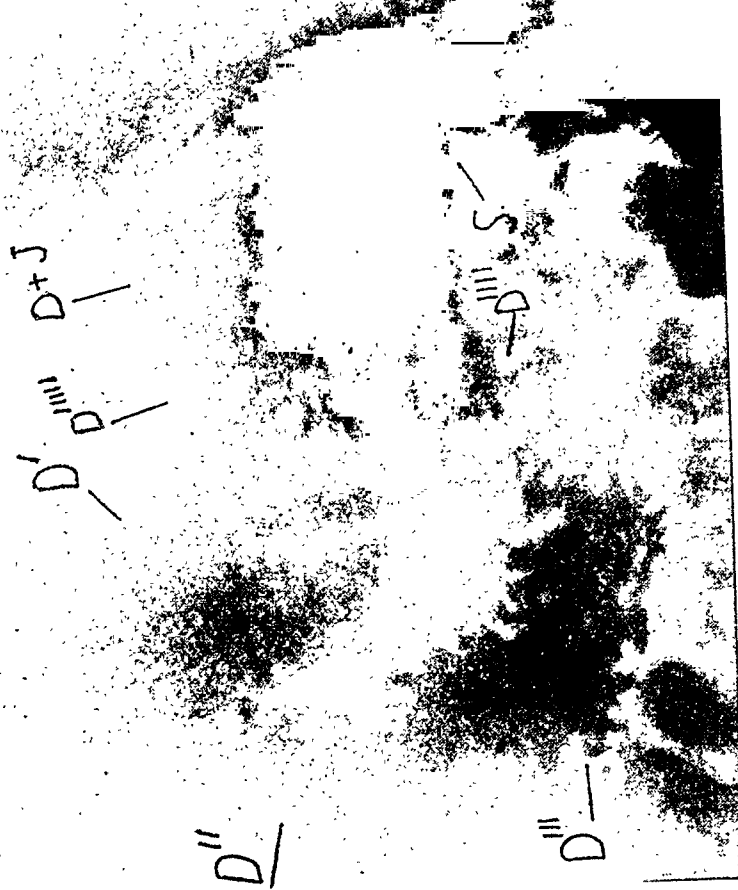


FIG. 14.—Mrs. S. Dilatation of entire duodenum.

enlarged and sensitive liver. In my experience, this is accompanied with pain referred to the right costal arch.

In all obstructions below the ampulla of Vater the symptoms may be grouped together, except for pain at the duodeno-jejunal junction, which seems to be peculiar to constriction at that point. If due to prolapse of the intestines, there may be periods of comfort when the bowels are functioning properly, but with constipation the drag of the distended bowel inaugurates an attack. This is probably the mechanism of so-called bilious attacks characterized by constipation, headache, and vomiting of bile.

The condition of the pylorus will modify the symptoms, for with a resistant pylorus pain is prominent, while with a relaxed one regurgitation or vomiting of bile occurs without pain. Two areas of discomfort are observed, a pain or dull ache at the left of the median line, slightly higher than the navel (the duodeno-jejunal junction), relieved by deep pressure, and a pain above and at the right of the navel, extending under the liver and to the shoulders. This may be colic-like, due to peristaltic unrest, or steady and dull, due to distention and often lasting until relieved by vomiting. Occasionally, pain is limited to the back and is referred to the midline between the shoulder-blades. It may be of an intense boring character. Following an attack of pain the patient may "feel something give" (apparently the resisting pylorus yielding to pressure), the pain subsides and vomiting or regurgitation of bile follows. Frequently patients obtain relief from deep pressure in the median line of the abdomen below the navel (presumably by unlocking the duodeno-jejunal kink). Attacks of pain may simulate biliary colic or duodenal ulcer or chronic appendicitis, and in operating for these conditions with negative findings, duodenal obstruction should be looked for. In the majority of the cases there will be a combination of both toxic and mechanical symptoms.

In contrast with the above, pain is usually absent in acute gastromesenteric ileus, or if present in the beginning, disappears with the prog-

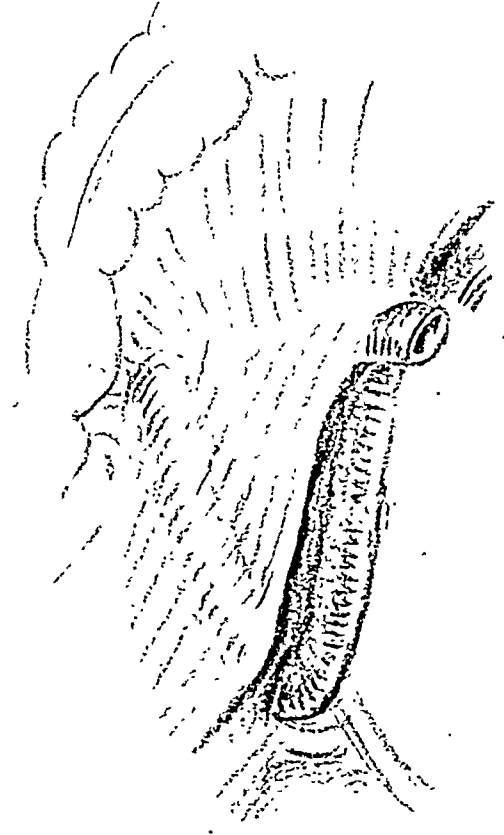


FIG. 15.—This is a type of duodenum described by Armstrong, Freeman and Aitken. In sixty-four autopsies at Harvard Medical School, five cases were observed in which the duodenum descended to the pelvic brim and ascended with a mesentery to the under surface of the transverse mesocolon. This sketch illustrates how a supposedly short loop posterior gastroenterostomy may really leave a long proximal loop predisposing to vicious circle. (Published with the permission of Mr. Aitken, whose paper will appear in the Boston Medical and Surgical Journal.)

ress of dilatation. This, with the absence of fever, accounts for the frequent failure to diagnose the condition.

TREATMENT

A minority of the cases are surgical from the beginning, notably those having a hugely dilated duodenum, or continuous and copious regurgitation of bile into the stomach.

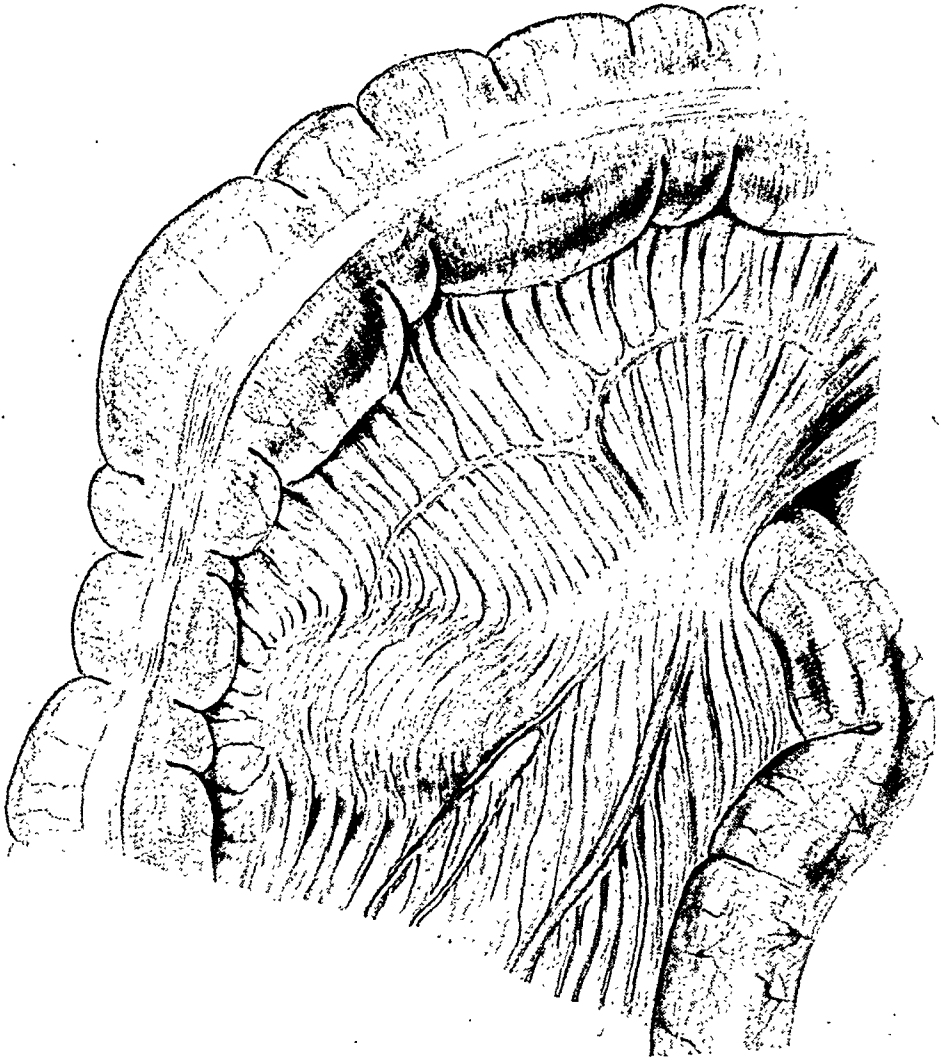


FIG. 16.—Duodeno-jejunostomy. The dilated third portion of the duodenum presents as an oval mass close to hepatic flexure of the colon.

In the greater number, the dilatation is less marked, but they have attacks of pain, or bile regurgitation, or toxic symptoms with intervals of comfort between the attacks, the symptoms often not pointing clearly to the duodenum. For these cases medical treatment should always be tried and it is usually successful. It consists of abdominal support, sleeping with foot of bed elevated, resting after meals, postural treatment,

abdominal massage and exercises, lavage, duodenal⁴⁸ and colonic irrigations, mineral oil, cathartics, rest cure and overfeeding.⁴⁹

When not successful, surgery is indicated. The procedure may be directed to the duodenum itself, or to some other part, the pathology of which is a factor in producing obstruction, frequently to both. The following operative procedures have been recommended: Jejunostomy, resection of duodenum and reuniting anterior to mesenteric vessels, approximation of recti muscles, gastroenterostomy, suturing the jejunum to under surface of transverse mesocolon, dividing adhesions with readjustment of duodenum, shortening the gastrohepatic omentum (Beyea⁵⁰), enlarging the mesenteric opening, stretching or dividing the ligament of Trietz, cholecyst-gastrostomy, or enterostomy (for papillary stenosis), suspending the transverse colon (Coffey⁵¹), plication and fixation of cæcum and ascending colon, with restoration of hepatic flexure, resection of cæcum and ascending colon, cholecystectomy (to prevent gall-bladder adhesions from reforming), duodeno-jejunostomy.

The choice of procedure will be determined by the subjective symptoms and mechanical conditions. In obstruction of first portion, dividing adhesions, the Beyea or Coffey operations or gastroenterostomy; of the second portion, the same, or cholecystectomy or duodeno-duodenostomy; of the third portion, some procedure to relieve the intestinal drag, Coffey operation, resection or plication and fixation of cæcum and ascending colon, duodeno-jejunostomy.

Duodeno-jejunostomy was suggested by Bloodgood¹⁵ in 1907 and first performed by Staveland⁵² in 1908. Since then the following cases have been reported:

In 1913, Bartlett⁵³ used a Murphy Button for duodeno-jejunostomy to relieve vicious circle after gastroenterostomy, and Allen⁵⁴ operated for traumatic retroperitoneal displacement of the duodenum, first doing a gastroenterostomy and afterwards duodeno-jejunostomy for persistent vomiting and emaciation.

In 1915, Corwin⁵⁵ reported an operation for giant duodenum and quoted W. J. Mayo, who said he had done the operation in one case with an unsatisfactory result.

In 1915, Beer⁵⁶ operated for an angioma of jejunum, first excluding the jejunum by a circular suture.

Ernst,⁵⁷ in 1916, successfully performed an anterior duodeno-jejunostomy on an eleven-day-old child for a congenital stenosis of the duodenum. This is the only report of its kind found in the literature.

Downes⁵⁸ reported an operation for giant duodenum in 1918, and in a personal communication states that he has performed the operation three times. He refers to a case operated upon by Beckman, of the Mayo Clinic.

In 1920, Collins,³⁰ discussing Freeman's paper, stated that he had performed the operation in one case, Quain³³ reported five cases, and Crouse³¹ recommends the procedure, but does not state the number of cases in which it was performed.

The writer,^{28, 29} reported twenty-three cases in 1918, and in this paper a further series of eighteen is added.

With the exception of Ernst's operation in a case of congenital stenosis, no cases are reported in the foreign literature.

Melchior,⁵⁹ in 1917, in "Die chirurgie des duodenum," refers to it as a procedure that can be considered in the presence of profound duodenal stenosis, but states that up to the present time gastroenterostomy is almost always performed.

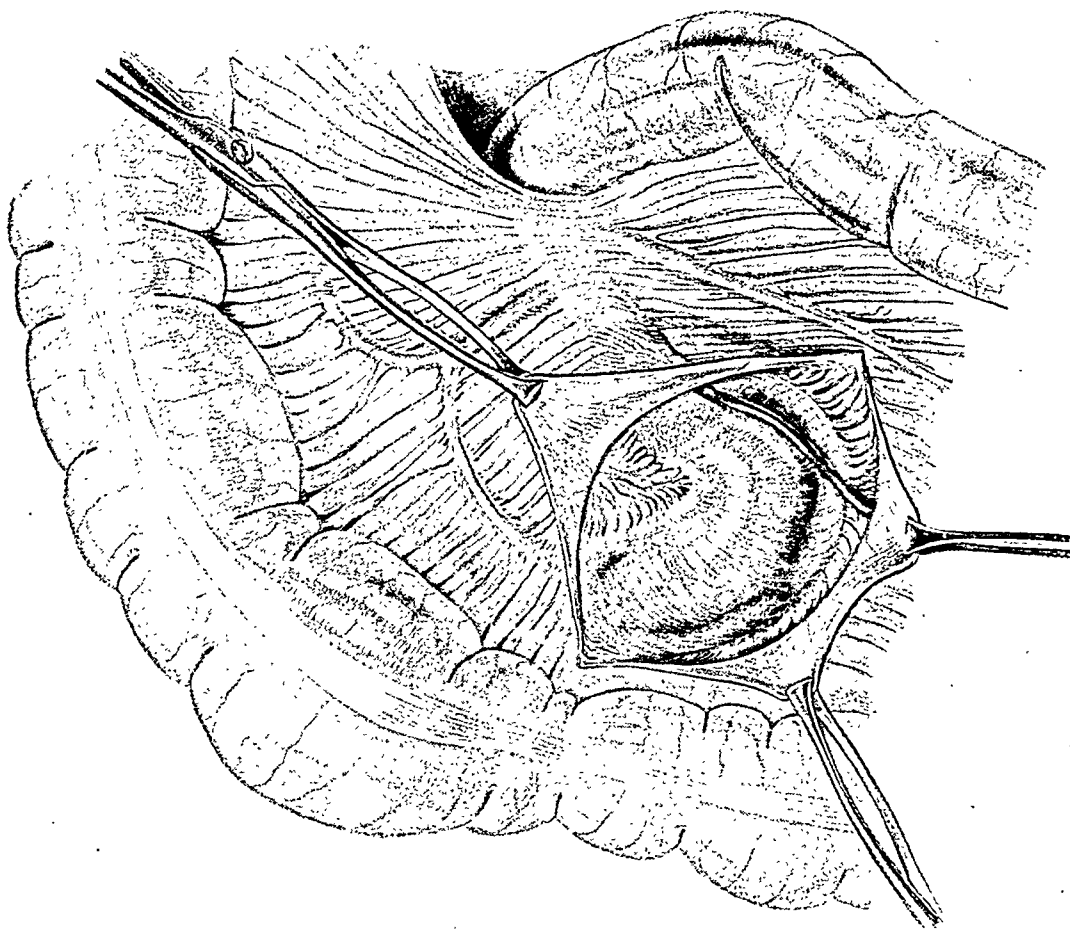


FIG. 17.—Duodeno-jejunostomy. The duodenum is exposed by an incision extending downward and inward. A large blood-vessel presents at the lower angle of the incision and may be easily injured. It should be represented in the peritoneal layer instead of behind it.

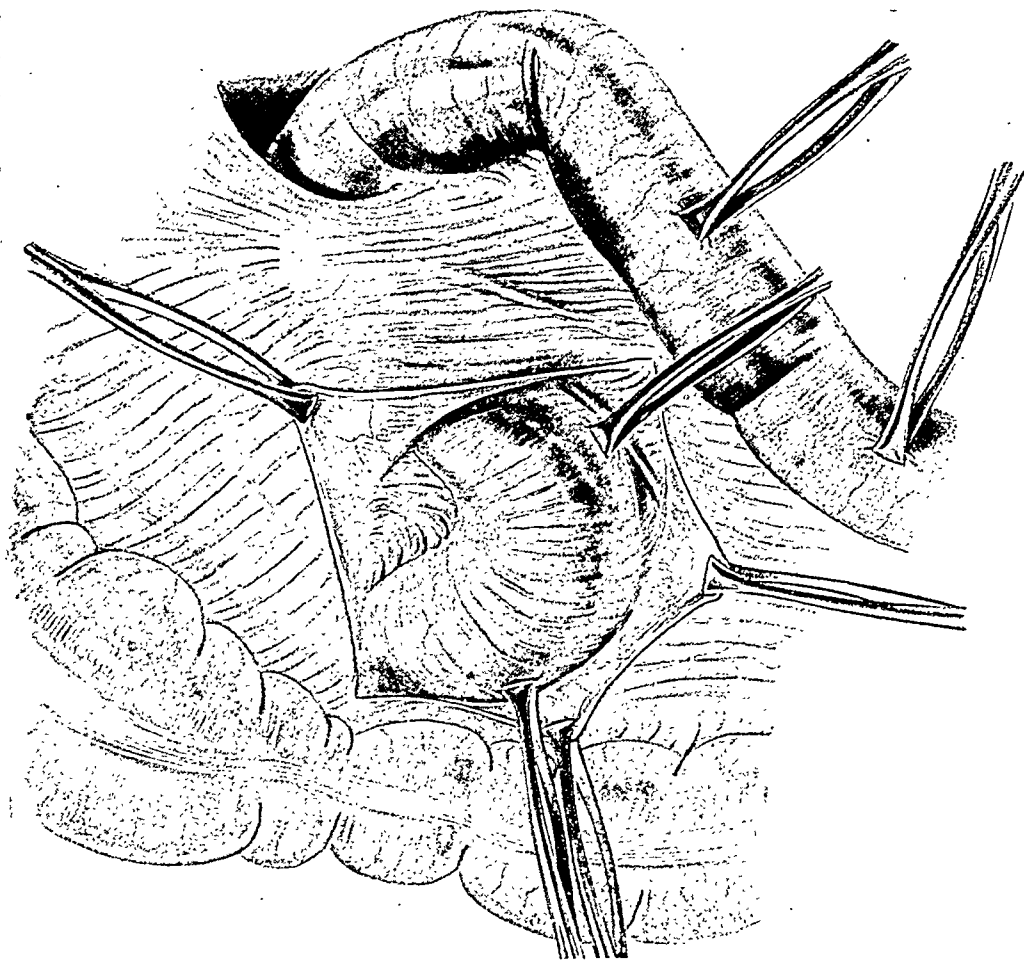


FIG. 18.—Duodeno-jejunostomy. Allis forceps are applied on the duodenum and jejunum to mark the points of the anastomosis.

CHRONIC DUODENAL OBSTRUCTION

The total number reported to date is fifty-eight. There has been no mortality and in only one case (Mayo's) is the result said to have been unsatisfactory. The literature contains no study of the procedure and for this reason the following conclusions are offered:

The indications are:

1. Vicious circle after gastroenterostomy.
2. Accompanying gastroenterostomy when the duodenum is obstructed.

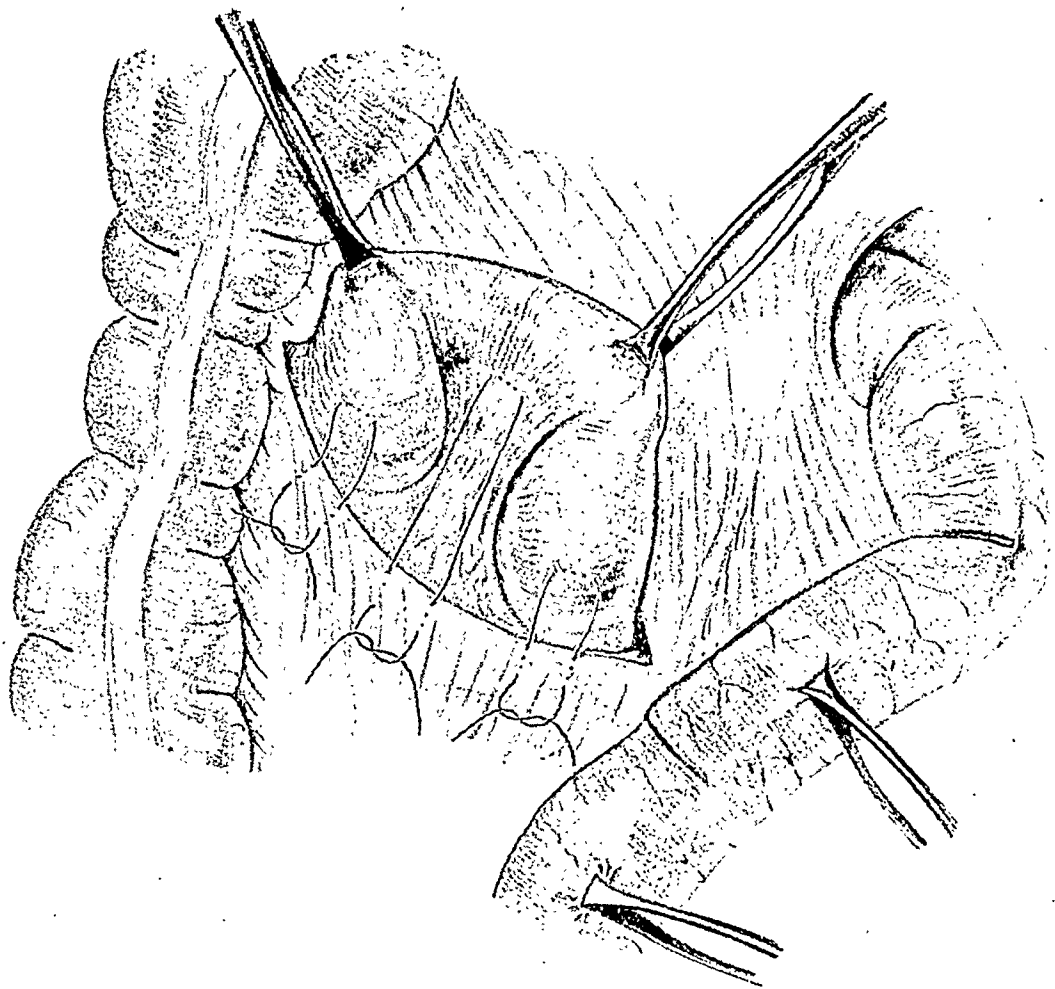


FIG. 19.—Duodeno-jejunostomy. The duodenum has been lifted from its bed after blunt dissection behind the second and third portions. Stitches are inserted for closing the peritoneal opening posteriorly. They pass through the peritoneal edge from without inward so as to invert the raw surface.

3. In place of gastroenterostomy in certain cases of duodenal ulcer.
4. Obstruction of the third portion of the duodenum, not responding to medical treatment, in which some other procedure is not specifically indicated.

5. Possibly in cases of congenital stenosis and acute gastromesenteric ileus.

Group One.—Cases of *vicious circle* follow one of two types. First, those who stand the condition well, in which the bile vomited is normal in color and odor, and strength is maintained. They frequently respond to lavage, immediately followed with food introduced through the stomach

tube, supplemented with peristaltic stimulants, massage, postural treatment and colon irrigations. If weight and strength progressively fail, however, operation will be required.

Second, those showing early toxic symptoms with marked prostration, subnormal temperature, rapid, feeble pulse, scanty urine and vomiting or regurgitation of dark bile having a fecal odor. These patients grow worse rapidly and require early operation. The procedure may consist of the treatment of angulations or adhesions, but usually duodeno-jejunostomy, with exclusion of pylorus, is advisable.

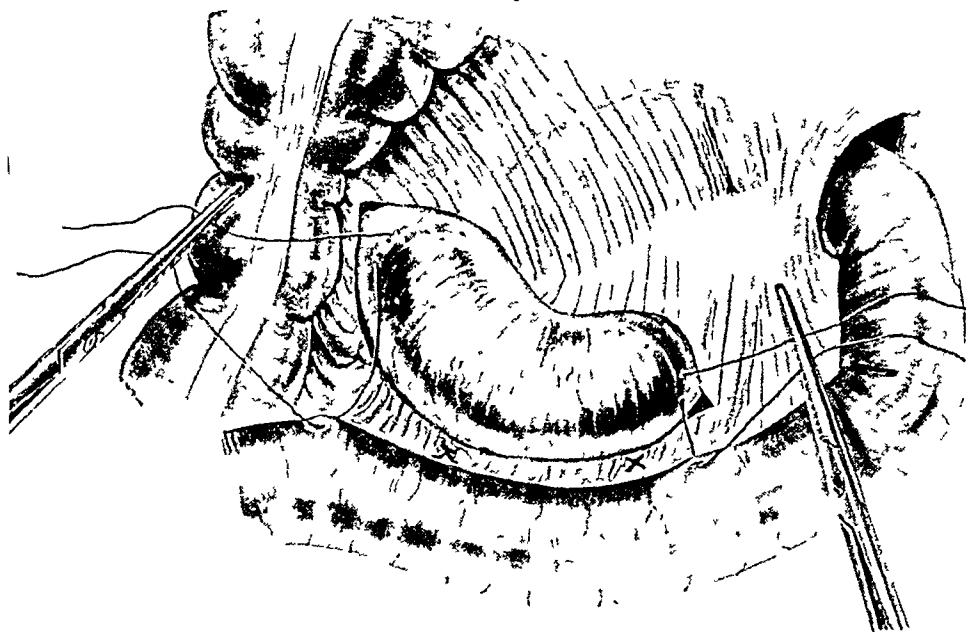


FIG 20.—Duodeno-jejunostomy Posterior peritoneal sutures are tied and traction stitches are inserted between the duodenum and jejunum. On the jejunal side they are close to the mesenteric border, so that the jejunal incision will be on the superior surface instead of the free border. These sutures aid in the manipulation of the duodenum, which tends to retract, and also prevent angulation at the point of anastomosis.

Group Two.—Accompanying gastroenterostomy when the duodenum is obstructed.

Gillon⁶⁰ considers gastroenterostomy an incomplete operation physiologically and recommends enteroenterostomy in all cases. American surgeons will consider this view extreme, but when it is done, one is impressed with the uniform smoothness of the convalescence. It is certain that some unfortunate results have been due to failure to recognize and to treat the duodenal obstruction.

Group Three.—As a substitute for gastroenterostomy in certain cases of duodenal ulcer. It is not uncommon for ulcer to complicate duodenal obstruction, and it has been suggested by Codman,¹⁷ Lane,²⁰ and the writer^{28, 29} that the duodenal obstruction is a predisposing cause. Codman,¹⁷ in particular, discusses the irritating properties of the pancreatic secretion and its effect upon the first portion of the duodenum. Occasion-

ally a case will be found in which gastric acidity is normal or diminished. There may be a gastric delay and bile is usually present in the stomach. The pylorus instead of being obstructed is dilated, a pathological condition below causing obstruction of the duodenum. The usual procedure has consisted in gastroenterostomy with pyloric exclusion, but in certain cases, in which the dilatation was extreme, duodeno-jejunostomy has been performed, with the assumption that there is an advantage in relieving the predisposing pathological condition, without disturbing the physiology of the stomach. The cases are too few in number to justify positive conclusions, however.

Group Four.—*Obstruction of the third portion of the duodenum* is the largest group and the one of which I have had the greatest opportunity to make a study. Among these are included, not only cases of giant duodenum, but a greater number, which, though showing a lesser degree of obstruction, present a very definite symptom-complex.

TECHNIC OF DUODENO-JEJUNOSTOMY

The operation is similar to gastroenterostomy, but there are some practical points worth emphasizing. (See Figs. 16 to 22.)

Incision: Upper right rectus or transverse if there is reason to anticipate the encountering of adhesions from previous operation. The dependent portion of the duodenum is located retroperitoneally, below the transverse colon, in close relation to the hepatic flexure. The peritoneum is incised obliquely downward and inward and the opening enlarged sufficiently to give a satisfactory exposure. Large blood-vessels will present at the inner angle.

The duodenum is freed by blunt dissection behind the descending and transverse portions. Free mobilization adds to the ease of the subsequent procedure. The duodenum is drawn forward and the edge of the mesenteric opening is sutured to it posteriorly.

The dependent portion of the duodenum and the superior surface of the jejunum are approximated and held with traction stitches. A continuous suture of fine linen softened with vaseline is inserted, a gastroenterostomy clamp is applied, and a one and one-half-inch incision is made in the duodenum and a slightly shorter one in the jejunum. The suturing is then completed as in gastroenterostomy, particular attention being given to the angle stitches. In completing the outer anterior stitch, the approximation must usually be made entirely at the expense of the jejunum. This may be facilitated by inserting the jejunal stitch at right angles to the incision and the duodenal stitch parallel with it. The opening in the mesentery is closed anteriorly by suturing to the duodenum. The procedure is more difficult than gastroenterostomy, but post-operative experience leads to the conclusion that the mortality is lower and complications are less apt to occur.

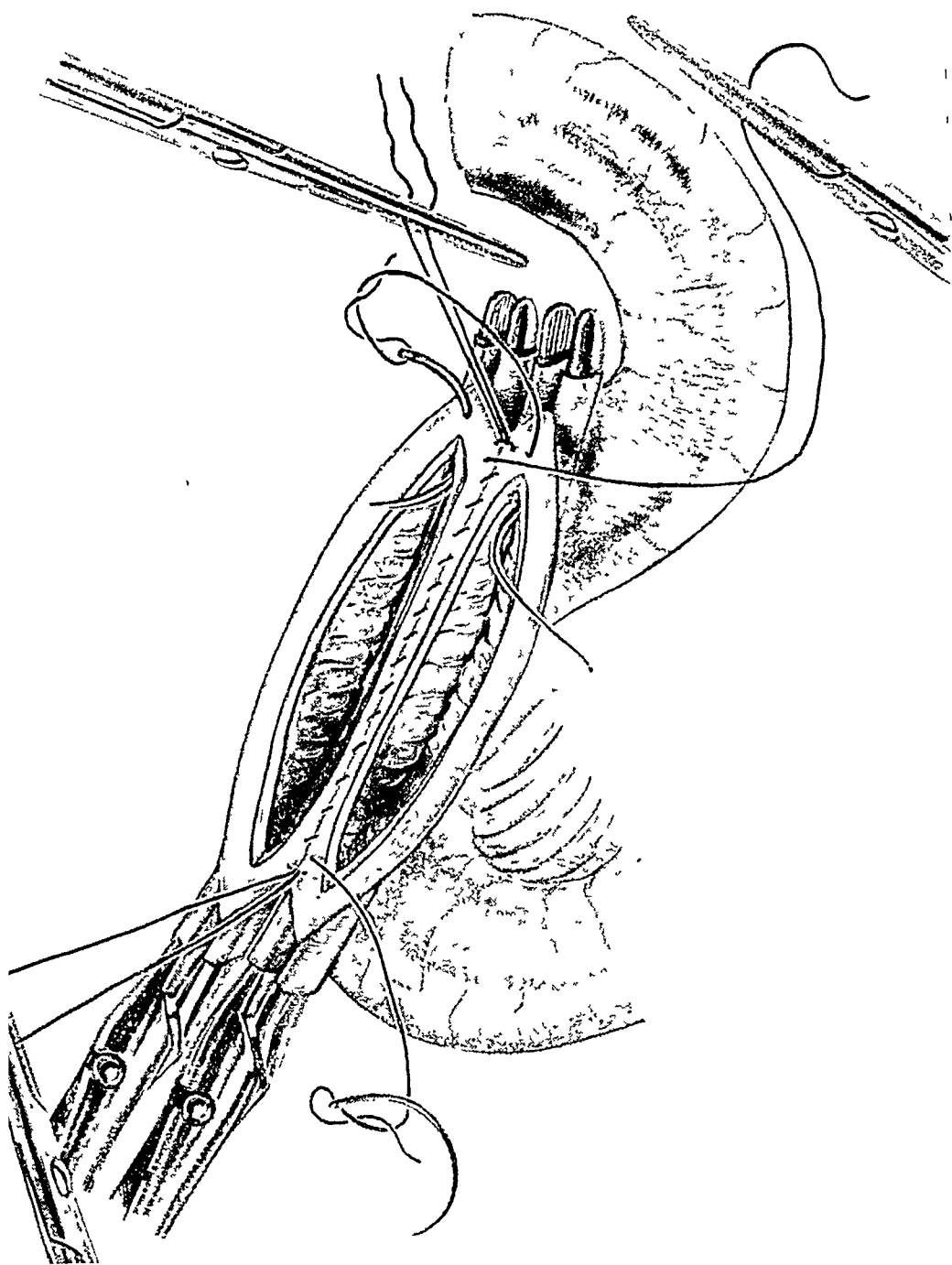


FIG. 21.—Duodeno-jejunostomy. Clamps are applied, traction sutures are tied, posterior suture of linen is inserted. The inner suture of chromic gut is started, indicating the care used in inserting the angle stitch. It is occasionally necessary to operate without a clamp on the duodenum.

CASE REPORTS

The following is a résumé of our series treated by duodeno-jejunostomy: Total number, forty-one. First duodeno-jejunostomy performed in 1915. Males, sixteen; females, twenty-five. Ages, ten to twenty, two; twenty to thirty, twelve; thirty to forty, fifteen; forty to fifty, eight; fifty to sixty, three.

Previous operations were performed in 22 cases: Gastroenterostomy, 8; appendectomy, 12; tubal pregnancy, 1; hysterectomy, 2; cholecystostomy, 1; cholecystectomy, 2; nephropexy, 2; laparotomy, 1.

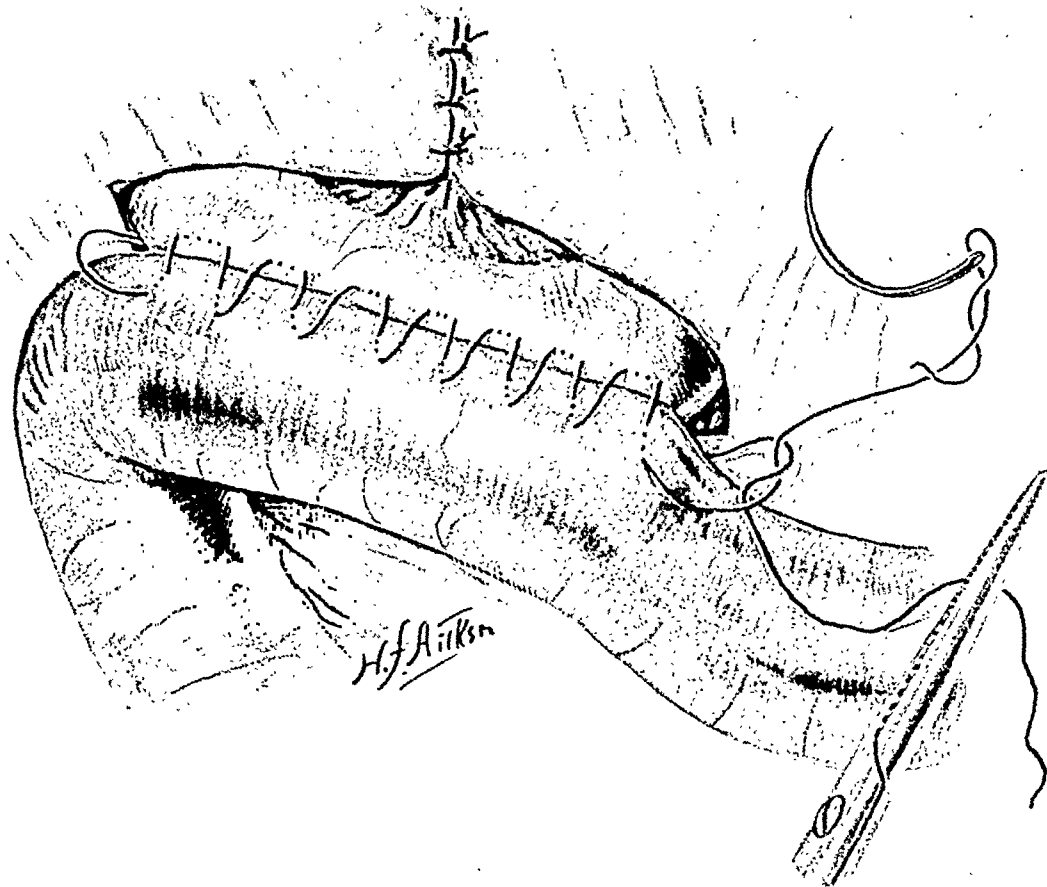


FIG. 22.—Duodeno-jejunostomy. The inner suture has been completed. The outer suture is inserted at right angles to the incision on the jejunal side and parallel with it on the duodenal side. This favors approximation at the expense of the jejunum which is frequently necessary because of the traction on the duodenum.

Symptoms have been grouped as follows: Headache, 27; regurgitation, 25; eructations, 30; borborygmus, 25; heartburn, 13; loss of weight, 35; constipation, 38; vomiting, 22; vomiting of bile, 19; vicious circle, 4; bilious attacks (constipation, headache and vomiting of bile), 9; pain, 34; localized in the epigastrium, 29; right hypochondrium, 7; at the duodeno-jejunal junction, 6; in the back, 9. The pain was definitely related to food in 11 cases. Dull in character in 11, sharp in 13, colic-like in 6. The gastric acidity was normal in 7, low in 9, high in 17 and not stated in 8. Impaired motor function and bile found in the fasting stomach was noted in 23 cases.

X-ray Report.—Correct diagnosis 18 in 33 examinations, ulcer wrongly diagnosed in 9 cases.

Pathology.—The stomach was dilated in 10 cases, ptosed in 3, and an ulcer found in 1. The duodenum showed an ulcer in 2 cases, was moderately dilated in 10, considerably in 11, greatly in 7, and not stated in 3. The cæcum was dilated in 15 cases, prolapsed in 10. Adhesions were about it in 4, and in 3 there was a Jackson membrane. The hepatic flexure showed adhesions or prolapse in 7 cases. Chronic appendicitis was found in 14. Adhesions or angulation at the gastroenterostomy opening found in 4 cases. The small intestines were in the pelvis in 4, the jejunum was angulated or adherent in 11.

The indications for which duodeno-jejunostomy was performed were as follows: 3 cases, 1 suggestive of gall-stones, the other 2 of chronic appendicitis, in which a dilated duodenum was found, 13 in which ulcer was suspected or diagnosed, but in which the pathology was a dilated duodenum, or adhesions about it, 3 cases, 2 with a duodenal ulcer and 1 with a gastric ulcer as well as a duodenal dilatation. In these a gastroenterostomy was also performed, 4 with vicious circle, 4 complaining of continued epigastric pain and vomiting of bile, after a previous gastroenterostomy had been performed by various surgeons and in which a dilated duodenum was demonstrated; 14 with epigastric pain, vomiting, or typical bilious attacks in which a dilated duodenum was suspected or diagnosed before operation. Four of these also showed ulcer of the duodenum. Of the 41 cases operated upon, 31 have been followed up to a recent date, and are so completely relieved of their symptoms that it is justified to classify them as cured; 5 cases were apparently cured at the time of their leaving the hospital, but we have been unable to get a subsequent report; 4 cases have been greatly improved, but still complain of some troublesome symptoms; one case feels that there has been no benefit from the operation.

The results convince us that duodeno-jejunostomy will save from invalidism a group of patients not amenable to other treatment, and should be recognized as a definite surgical procedure with well-defined indications and limitations.

The following case reports have been selected as illustrating variations in the problem of duodenal obstruction.

In the table a summary is given of the forty-one cases in which duodeno-jejunostomy was performed.

CASE I. *Indication: Vicious Circle.* No. 23, Mr. T. A., aged thirty-four years.

Past History.—Always constipated, symptoms of indigestion commenced in 1913. Appendectomy in 1914 gave temporary relief.

Present History.—Complains of frequent attacks of acid stomach with moderate pain one hour after meals and when stomach is empty, occasionally vomits acid material. Usually awakened at

CHRONIC DUODENAL OBSTRUCTION

4.00 A.M. with nervousness, headache and sour eructations which are relieved by forced vomiting.

Physical Examination.—Stomach normal to palpation. Duodenum demonstrated by percussion as dilated. Motor tests show a gastric delay. Fasting stomach empty. Ewald test meal—free hydrochloric acid, 34. *Operation*, June, 1918.

Pathology.—Ulcer at the pylorus causing partial obstruction. No note made as to condition of duodenum.

Procedure.—Posterior gastroenterostomy with pyloric exclusion.

Result.—After five days patient commenced vomiting large quantities of bile. Lavage, cathartics and postural treatment gave no relief. Gradually grew weaker with subnormal temperature and scanty urine elimination.

Second Operation (July, 1919, for vicious circle).—*Pathology.*—Adhesions found at point of anastomosis, gastroenterostomy opening admitted three fingers. Pylorus still closed. Duodenum not dilated, probably because the bile flowed freely into the stomach. *Procedure.*—Duodeno-jejunostomy. *Result.*—Complete recovery. Remains well up to the present time.

Remarks.—Duodenal obstruction was suspected from the physical examination, but was overlooked at the first operation. Duodeno-jejunostomy should have supplemented the gastroenterostomy at the original operation.

CASE II. *Indication: Dilated Duodenum After a Previous Gastroenterostomy.* Number 3, Miss D. B., aged twenty-four years.

Past History.—For many years complained of indigestion, constipation, headaches, vomiting spells and cramp-like pains in the upper abdomen, not related to meals. Accustomed to wash out her own stomach frequently. Appendectomy in March, 1915, without improvement. Gastroenterostomy in October, 1915, with relief for eighteen months.

Present History.—Complains of epigastric pain, heartburn, headache, backache, constipation, and vomiting of food and bile.

Operation, February, 1917. *Pathology.*—Markedly dilated duodenum. *Procedure.*—Duodeno-jejunostomy. *Result.*—All symptoms disappeared and the patient has remained well up to the present time.

CASE III. *Indication: Dilated Duodenum Subsequent to Gastroenterostomy.* Number 12, Miss M. R., aged thirty-seven years.

Past History.—Appendectomy and gastroenterostomy for gastric ulcer in 1915. Well for one year.

Present History.—For two years has had recurring attacks of indigestion, occurring about once in two weeks, dull aching pain in epigastrium, in right hypochondrium and at the left of the navel, becoming cramp-like at times. During the attacks, food increased the discomfort. Frequently became nauseated but did not vomit.

Examination.—Abdominal tenderness in right hypochondrium, at the left of the navel and in the lower left quadrant. Slight rigidity of the upper right rectus. Stomach outline normal, duodenum not

outlined. No free HCl. The X-ray showed a slight delay in the stomach and duodenal cap.

Operation, January, 1918. Pathology.—Gastroenterostomy patent, adhesions about it. Entire duodenum dilated.

Procedure.—Duodeno-jejunostomy.

Result.—Complete recovery, has remained well for two years.

Remarks.—There is no information as to the condition of the duodenum before the first operation. Apparently the obstruction resulted from adhesions following the first operation. Bile did not regurgitate readily and for that reason pain was a prominent symptom.

CASE IV. Indication: Dilated Duodenum, After a Previous Gastroenterostomy. Number 1, Miss A. B., aged twenty-five years.

Past History.—In 1912 she began to have abdominal distress following meals and attacks of vomiting from one-half to two hours after meals. Vomitus was sour, but did not show retention. In 1913 a gastroenterostomy was performed which greatly relieved her for a year, although she had occasional attacks of vomiting.

Present History.—For past six months all symptoms have returned. Has lost forty pounds in weight. Marked headache and weakness. After admission to the hospital patient vomited after nearly every meal.

Examination.—Slight tenderness in upper right quadrant and in left iliac region. Dermatitis over left thigh. The test meal showed normal secretion.

Exploratory operation, January, 1915. Pathology.—Adhesions between the stomach and gall-bladder. The duodenum was markedly dilated and presented prominently below the transverse colon.

Procedure.—Adhesions divided, pylorus occluded, duodeno-jejunostomy performed.

Result.—For five days vomited frequently, after which all symptoms cleared up. She has continued perfectly well for five years.

Remarks.—The diagnosis was not made until the abdomen was opened. It is probable that the condition existed prior to the first operation, but may have been produced by it. The indications for the original gastroenterostomy do not appear to have been very clear. The recovery was complete and spectacular.

CASE V. Indication: Dilated Duodenum. Number 7, Miss D. B., aged thirty-seven years.

Past History.—Operation for tubal pregnancy in 1913. Pyelitis in 1915.

Present History.—Since 1916 has complained of epigastric pain before, during or immediately after meals, not relieved by food, but relieved by lying flat on her back.

Physical Examination.—Negative, except for moderate epigastric tenderness. Three out of four thread tests showed a trace of blood. Ewald test meal: Specimen scanty, largely mucus; free HCl, none; total acidity, 30.

A modified ulcer treatment gave relief for a time, but after ten

CHRONIC DUODENAL OBSTRUCTION

months the symptoms returned and at this time there was tenderness over the region of the appendix. A test meal showed free HCl of 28. Motor function tests showed a slight gastric delay. No bile found in the stomach. The X-ray suggested gall-stones.

Exploratory operation in August, 1917. *Pathology*.—Appendix thickened, covered with light adhesions. Duodenum hugely dilated. On its anterior wall was the scar of a small ulcer apparently healed. There were adhesions between the gall-bladder and duodenum, but no gall-stones.

Procedure.—Appendectomy, division of adhesions, duodeno-jejunostomy.

Result.—Uneventful convalescence. Remains well, three years after operation.

Remarks.—The duodenal dilatation was not recognized by the physical or X-ray examination. The gastric analysis was not suggestive of ulcer. Chronic appendicitis might have given the symptoms, but with the pathology described, appendectomy alone would probably have failed to cure. Gastroenterostomy with pyloric exclusion was considered, but since the acidity was not high, the ulcer apparently healed and the dilated duodenum dominated the pathology, duodeno-jejunostomy seemed indicated.

CASE VI. *Indication: Dilatation of Entire Duodenum*. Number 25, Miss S. L., aged twenty-five years.

Past History.—Appendectomy in 1918 for same symptoms now complained of.

Present History.—For ten years has had "terrible" backache, located between shoulder blades. It is described as intense and boring in character. During attacks it is continuous, but much worse about two hours after meals. Has acid regurgitation and frequent eructations, is constipated, nervous and depressed.

Examination.—Stomach normal in size and position, duodenum cannot be outlined, cæcum and ascending colon distended with gas. Sensitive to pressure in epigastrium, liver normal. Test meal: Free HCl 38. Motor tests show normal motor function. Lavage of fasting stomach shows mucus and acid fluid. Tests for occult blood, negative.

X-ray diagnosis, duodenal stasis, probably caused by adhesions at beginning of third portion, mobile cæcum, dilated and ptosed in pelvis. Medical treatment was undertaken without benefit and operation ultimately advised.

Operation, January 23, 1920. *Pathology*.—Definite bands extended from gall-bladder across the second portion of duodenum to transverse colon. There was a distinct narrowing of intestine at duodeno-jejunal junction, entire duodenum dilated, cæcum prolapsed and dilated.

Procedure.—Adhesions divided, cæcum plicated and sutured to posterior peritoneum, duodeno-jejunostomy.

Result.—Uneventful convalescence, backache entirely relieved,

bowels regular. One year from date of operation patient remains well, has gained in weight and strength.

Remarks.—The pain in back sometimes takes the place of abdominal pain. Because of its severity and relation to meals, duodenal ulcer was suspected. In this case no bile regurgitated into stomach and pain was the most prominent symptom, presumably because the pylorus did not yield to the pressure.

CASE VII. *Indication: Markedly Obstructed Duodenum with an Incompetent Pylorus.* Number 10, Mrs. E. B., aged forty-seven years.

Past History.—Digestive trouble for two and one-half years. Hysterectomy and cholecystostomy performed.

Present History.—Complains particularly of hyperæsthesia of tongue, œsophagus, and stomach. Every week or two she vomits large quantities of bile and in the interim frequently regurgitates it. There is no pain, but a very sore feeling in the upper abdomen. She complains of weakness and has lost weight.

Examination.—HCl diminished, motor tests show delay. Slight resistance over upper right rectus, percussion of duodenum shows moderate dilatation. There is moderate tenderness in this region. Lavage of fasting stomach shows bile constantly present. X-ray report suggests duodenal ulcer but does not refer to duodenal dilatation.

Operation, December, 1917. Pathology.—No ulcer demonstrated. Adhesions at hepatic flexure of colon involving gall-bladder and duodenum. The latter was dilated, extending for three fingers' breadth below attachment of transverse colon, pylorus dilated.

Procedure.—Adhesions divided, duodeno-jejunostomy performed.

Result.—Vomiting and bile regurgitation has ceased, abdominal soreness and hyperæsthesia have disappeared, appetite improved, has gained in weight and strength, remains well after three years.

Remarks.—It is probable that this condition existed from the beginning of her illness, and that the previous operations were performed under the impression that her digestive symptoms were reflex. The diagnosis was easily made from the history and physical examination in spite of the negative X-ray report. The failure of the X-ray examination to demonstrate the condition may have been due to improper technic or to the fact that because of the incompetent pylorus permitting regurgitation of bile, the dilatation was not constantly present. The hyperæsthesia was probably due to irritation by the regurgitated bile.

SUMMARY

1. Chronic duodenal obstruction occurs more commonly than is realized and can often be diagnosed from the history and physical signs.
2. The most interesting articles dealing with this condition are by Robinson (1900), Conner (1906), Bloodgood (1907), and Codman (1908).
3. Experimentally, it has been shown that animals with an isolated duodenal loop die of a chemical rather than bacterial poisoning.

CHRONIC DUODENAL OBSTRUCTION

4. The obstruction may involve the first or second portions of the duodenum only, due to ulcer, or gastropexy or adhesions; or the entire duodenum, most frequently caused by compression between the vertebral column behind and the superior mesenteric artery in front, especially when there is traction in the direction of the pelvis from the drag of a distended and ptosed cæcum and colon.

5. The physical signs of obstruction in the first portion are those of pyloric obstruction. When the second and third portions are involved it can often be made out by percussion and succussion.

6. X-ray frequently fails to show duodenal obstruction, but may be rendered more effective if a special technic is used.

7. The symptoms are those of epigastric discomfort and toxic manifestations. With a competent pylorus, cramp-like pains predominate, when incompetent, regurgitation of bile is frequent. "Bilious attacks" are probably due to duodenal obstruction.

8. The symptoms are often suggestive of ulcer, gall-bladder, or appendicular trouble, and in operating for these conditions with negative findings the duodenum should be carefully examined.

9. Medical treatment, consisting of abdominal support, nutritious diet and anti-constipation measures, is beneficial in the majority of cases.

10. Surgical treatment in obstruction of the first and second portions consists of freeing of adhesions, gastropexy or duodeno-duodenostomy. In the third portion the procedure of choice is duodeno-jejunostomy.

11. Duodeno-jejunostomy is indicated in (a) vicious circle after gastroenterostomy, (b) accompanying gastroenterostomy when the duodenum is obstructed, (c) in obstruction of the third portion not responding to medical treatment.

12. The total number of duodeno-jejunostomies reported are fifty-eight. There has been no mortality. In the author's series, thirty-six were completely relieved of very troublesome symptoms, four were markedly improved, and only one unimproved.

13. Duodeno-jejunostomy will save from invalidism a group of patients not amenable to other treatment and should be recognized as a definite surgical procedure.

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SYMPHYSIOTOMY AS AN AID TO THE REMOVAL OF CANCER OF THE PROSTATE

A PROPOSED NEW OPERATION

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ALL operators who have excised cancer of the prostate by Young's perineal method fully realize the difficulties in technic of the operation, as well as the impossibility of carrying out the procedure under direct vision. By experimentation on cadavers I have found that a symphysiotomy or pubiotomy not only greatly facilitates the removal, but also enables the surgeon to see clearly the extent of the diseased process and to do the repair of bladder and urethra with precision. The steps of the operation are as follows:

1. Expose the bladder in the same manner as is done in an ordinary suprapubic operation.

2. Open the bladder to confirm the diagnosis, and to ascertain the extent of the invasion of the vesical neck.

3. Divide the symphysis, pubic ligaments and attachment of the triangular ligament.

4. Abduct the leg slightly; this procedure separates the cut ends of the bone. It will be found that an abduction of about six inches makes a separation of from $1\frac{1}{2}$ to 2 inches.

5. Divide the bladder transversely near the vesical neck. The incision through the wall should be as near the prostate as the growth will allow.

6. After the bladder has been completely divided posteriorly the seminal vesicles will be exposed; these are then ligated and cut.

7. The urethra is now cut across at its junction with the prostate.

8. Separate the prostate carefully from the surrounding structures. Expose the inferior vesical artery and the branch of the superior vesical artery and ligate them. Continue the enucleation until the gland is free, so that it can be removed.

9. Make an opening through the perineum for drainage.

10. Close the posterior three-fourths of the bladder wound leaving a small opening at the anterior angle for the connection of the urethra to the bladder, then suture cut end of the urethra to the opening left in the bladder.

11. Close the symphysis with heavy silver wire.

12. Place the proper drains and close the wound.

The experience of obstetricians is that the bones after pubic pubiotomy quickly unite by fibrous union, and that the patient is able to walk within a comparatively short time. Even if union does not occur, walking is not materially interfered with, since the pubes do not have to carry much weight.

Although I have not as yet had the opportunity of performing this operation on a patient, I am convinced that it is thoroughly practicable and should have a field of great usefulness in excision of malignant tumors of the prostate.

THE SECRETORY PRESSURE OF THE KIDNEY AS AN INDEX OF PATHOLOGIC CONDITIONS

(PRELIMINARY REPORT)

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THE secretory pressure of the kidney has not been determined in man, but in the dog it has been found that with the ureter occluded the intrapelvic pressure increases rapidly up to 40 mm. of mercury, and then more slowly up to 60; at the latter point it ceases to rise, and the secretion of the kidney stops.

The secretory pressure of the kidney is most probably due to osmotic action, and does not depend on the blood-pressure.

It occurred to me that the normal secretory pressure should vary with pathological conditions, and that, if this variation could be determined, it might act as an accurate index of kidney function.

To measure this pressure plus the pressure caused by the contraction of the muscle of the renal pelvis and ureter I have constructed a simple device, which is shown in the accompanying cut.

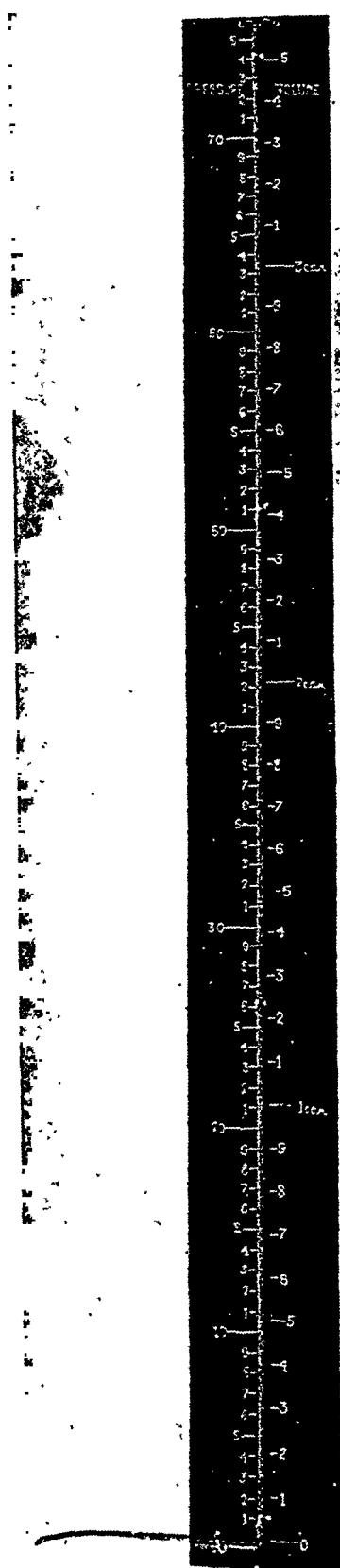
Description of the Apparatus.—The apparatus is made of a small glass tube with an inside diameter of 2 mm. and a length of 1.01 m. It is bent at a right angle at the lower end and fixed to a board 1.03 m. in length and 10.3 cm. in width. The lower end of the tube is drawn to a point, to which a piece of rubber tubing is attached. On the face of the board there are two scales, one for measuring in cubic millimetres the volume of urine secreted, and the other for indicating the intrapelvic pressure in terms of millimetres of mercury. The scale on the volume side was determined by means of a burette, and the pressure scale by a mercury manometer.

Plan of Procedure.—A renal catheter, No. 7 or 8, is introduced into the pelvis of the kidney, or high up into the ureter. It is necessary to employ as large a catheter as can be introduced into the ureter in order to prevent leakage of urine around it into the bladder. After the flow of urine is well established, the exposed end of the catheter is inserted into the rubber tubing connected with the instrument. The apparatus is then held upright and adjusted so that the zero point on the lower end of the scale is approximately on a level with the patient's kidney. I have found that the urine rapidly rises to a certain height and then begins to oscillate and to ascend much more slowly. This point of oscillation is usually reached in about twenty minutes, and is taken as an arbitrary point for reading. In a normal kidney the pressure, according to this, is from thirty-five to forty-five.

In addition to reading the pressure, the amount of each secretion may

THE SECRETORY PRESSURE OF THE KIDNEYS

be measured by the scale on the volume side, and the interval of time between secretions noted. If the catheter is in the ureter, the intervals of



secretion are quite marked, but if it is in the pelvis, the secretion is more constant; even then slight interval rises are to be observed. Both kidneys may be tested simultaneously or separately.

Results.—I have not employed this method sufficiently to make any definite claims for its value, but the results so far obtained indicate that it has a place as an additional means of renal diagnosis. And, theoretically, it may open up a wide field of clinical research, not only in surgical diseases of the kidney, but in all forms of nephritis as well.

There should not be the slightest danger in the use of this procedure, provided it is done in a proper manner and not continued too long. Twenty minutes is long enough to give a reading, and it is not possible that this could cause the least damage. In one instance in which the method was continued for forty-five minutes it produced bleeding, and it is readily conceivable that keeping the catheter in for an hour or longer, under high pressure, might do harm.

Sterilization.—The apparatus is sterilized by filling the tube with bichloride of mercury solution 1:1000 and allowing it to stand for one hour. Care must be taken to see that all of the solution is out of the tube before the apparatus is used.

The following cases have been selected as illustrations:

CASE No. I.—Male, aged thirty-four years. Complained of having passed renal calculi. Complete examination, comprising phenolsulphonaphthalein, X-ray, etc., showed no abnormal condition. Pressure at the end of twenty minutes on right side, forty-three. Pressure at the end of twenty minutes on left side, forty-two. The above is an example of normal kidneys.

CASE No. II.—Male, aged twenty-seven years. Advanced parenchymatous nephritis with double pyelitis. Pressure on right side, twenty-five. Pressure on left side, twelve.

CASE No. III.—Male, aged thirty-two years. Chronic nephritis with pyelitis. Pressure, right side, twenty-seven. Pressure, left side, twenty-five.

CASE No. IV.—Male, aged thirty-six years. Left pyelitis with nephritis of corresponding kidney. Pressure, right side, twenty-nine. Pressure, left side, twelve.

CASE No. V.—Male, aged thirty-two years. Moderate degree of hydronephrosis left side. Pressure, left side, twelve. Pressure, right side, not taken.

CASE No. VI.—Male, aged fifty-eight years. Hydronephrosis on the left side. Pressure, left side, eighteen. Pressure, right side, twenty-nine.

CASE No. VII.—Male, aged thirty-six years. Stricture of lower end of left ureter with mild degree of hydronephrosis. It was impossible to pass a larger catheter than a No. 5 on the affected side and a No. 6 on the sound side. The pressure rose on each side to ten and twelve, respectively, then began to oscillate, and finally fell to six. From the marked oscillation it was clearly evident that the urine was leaking around the catheters, consequently no reading could be obtained.

Clinical investigations and experimental work on animals are being continued and will be reported later. This preliminary report is made hoping that someone who has more diversified material at hand may be interested and will test the method further.

SLIDING HERNIA OF THE URETER

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THE experienced operator will never give credence to the assertion that the surgery of hernias is routine and uninteresting. In diagnosis often supported solely by the patient's conviction, in complications presenting the most spectacular disasters, and in operative findings yielding the most unexpected range of structural pathology, hernias demand and exact the most philosophical and resourceful surgery.

The sliding type of hernia is a not uncommon nor disrespected pitfall of the rapid and confident operator. It has been well said that the incidence of sliding hernias is greater than would be estimated from those reported, for the reason that most surgeons are eager to forget them. The hernia of the ureter under consideration is not easily forgotten, inasmuch as the possibility of its occurrence was unknown to us and to our surgical friends. A study of the literature revealed but a single analogous case, and that one reported very recently.

Briefly, the sliding hernia is a hernia of an organ either totally or in part extraperitoneal, either with or without a sac or partially sacculated, and either associated or unassociated with herniation of intraperitoneal viscera. The great majority are inguinal hernias, but half a dozen femoral sliding hernias having been reported. Judd (*Mayo Clinic Papers*, 1909) recorded 14 sliding hernias in 1653 herniotomies. Davis (*Jour. Amer. Med. Asso.*, August 12, 1916) reported 7 in 1500 herniotomies, while Eccles ("Hernia, Its Etiology, Symptoms and Treatment," 1900) estimated that the bladder "slid" into 1 per cent. of inguinal hernias.

Types of Sliding Hernias.—Moschcowitz (*ANNALS OF SURGERY*, 1914, lix, p. 610) established and elaborated the principles of sliding hernias. He asserted that the greater the uncovered area of an organ the more likely is the organ to become part of a sliding hernia. The ureter, he states, is, or should be, according to this premise, always a component of a sliding hernia. Yet neither Moschcowitz nor any other writer, with a single exception, has spoken of the actual finding of the ureter as an integral part of a sliding hernia. Moschcowitz classifies the following organs as "likely" to form sliding hernias: the ascending and descending colon, the broad ligament, the bladder and the appendix; and as those "rarely" participating the sigmoid, small intestine, uterus and Fallopian tubes.

Moschcowitz further classifies sliding hernias as those created by

"pulling" and those created by "pushing." Those which are "pulled" (ostensibly by the sac and contents of an inguinal hernia) are large hernias with a large sac. Those which are "pushed" (ostensibly by some increase or unequal distribution of intraabdominal pressure) are small hernias usually without a sac. Where the sac exists, the sliding component is found to its outer side and posteriorly.

Excepting possibly the bladder, by far the commonest organ found in the sliding hernia is the cæcum or ascending colon with or without the appendix. All but a few of the sixty-three cases reported by Gibbon (*Jour. Amer. Med. Asso.*, xxxi, 1898, p. 1385) were of the cæcum. Carnett (*ANNALS OF SURGERY*, 1909, xlix, p. 491), in discussing nine cecal hernias, emphasizes the importance of anomalous peritonealization of the cæcum in predisposing to its association with sliding hernias. Incomplete investiture of the cæcum with peritoneum when the latter becomes fused with the mesocolon, or the retention of an unusually long and redundant mesocolon, may threaten it with herniation.

Marshall (*Wisconsin Med. Jour.*, 1914-15, xiii, p. 99) advances a further etiological factor in the formation of cecal hernias. The ligament of the testis, by its intimate attachment to the mesentery of the cæcum, appendix and ileum, is thought to serve as the strand by which the testicle, during its descent, might drag behind it these willing structures. Adhesions are thought to facilitate this defection.

Literature.—Ransohoff (*ANNALS OF SURGERY*, lvi, 1912, p. 313), Rockey (*Northwest Med.*, 1914, vi, p. 294), Walton (*ANNALS OF SURGERY*, January, 1913), Wier (*Med. Rec.*, lvii, 8, February 24, 1900, p. 309), Hotchkiss (*ANNALS OF SURGERY*, l, 2, August, 1919, p. 470), Davis (*Jour. Amer. Med. Asso.*, August 12, 1916), Fiaschi (*Australas. Med. Gaz.*, November 20, 1907), Thornton (*Jour. Iowa Med. Soc.*, 7, 71, February, 1917), Unwin (*Brit. Med. Jour.*, 1915, i, p. 329), McMahan (*Jour. Tenn. Med. Asso.*, 9, 431, March, 1917), and Sprengel (*Arch. Klin. Chir.*, 95, 702) are writers of recent and interesting reports upon sliding hernias. Their cases considered number *in toto* about seventy, and none of them have found the ureter in a sliding hernia.

Historically, the collection by Foerster of fifty-four left-sided cases (*U. of P. Med. Bull.*, December, 1901), by Gibbon of sixty-three cases (*Jour. Amer. Med. Asso.*, xxxi, 1898, p. 1385), by Hildebrand of 139 (*Deut. Zeit. f. Chir.*, 1892, xxxiii, p. 182), and by Baumgartner of 159 cases (*Thèse de Paris*, 1905) present exhaustive studies of the mechanism and components of sliding hernias. None of them record finding the ureter. Baumgartner cites three cases of sliding hernia in which the kidney on the corresponding side was displaced downward several inches, together with the aorta and vena cava, and quotes Tuffier's assertion that a general visceroptosis is a not uncommon sequel of large sliding hernias.

Bennett and Cunningham (*Sectional Anatomy*, 1888), in making sections of a foetus harboring a large cecal hernia, observed that the right

ureter had been dragged forward two inches and occupied a position close to the neck of the sac.

The only case analogous to the one here recorded is that of Griep (*Med. Klin.*, 16:24, June, 1920). In operating upon a large left-sided hernia at the Red Cross Hospital in Kassel he encountered the left ureter prolapsed into the inguinal canal and dilated sufficiently to admit a No. 20 French catheter. The extent of the prolapse was not recorded. The urine was normal and there was no evident etiology.

Protocol of Case.—F. O., a Polish coal miner, aged thirty-three years, was admitted to the University Hospital, Philadelphia, on October 10, 1920. For the past eighteen years he had had a right inguinal hernia which had grown so large as to cause some disability but no discomfort or pain. The previous history was negative save for smallpox in childhood.

The patient complained of nothing except the hernia. After the operation it was determined with the aid of an interpreter that for the preceding two years the patient had some frequency of urination during the day, voiding about every two hours. There was no two-stage micturition occasionally met with in hernia of the bladder.

Physically, the patient presented no abnormalities save indistinct pock-marks about the face and neck, and a very large right scrotal inguinal hernia. When the patient stood, the scrotum reached half way to the knee, and its dimensions were about those of a football. The hernia was easily reducible through an enormously dilated inguinal canal. The testicle occupied the most dependent portion of the scrotum, and the contents of the sac yielded a resonant note throughout.

Blood-pressure, 140-85; the blood-count normal; phthalein elimination, 45 per cent. in two hours and ten minutes.

Operation (October 11, 1920).—Doctor George G. Ross exposed the sac in the usual manner and freed it without difficulty from its attachment to the bottom of the scrotum. The sac was about seven inches long, three inches in diameter and one-eighth inch in thickness.

The sac was opened, and its contents, composed entirely of small intestine, reduced without difficulty. The sac was then separated from surrounding structures in the neighborhood of the internal ring. A protrusion about the size of a golf ball was noted immediately to the outer side of the neck of the sac. It was thought to be a part of the sac or a second sac, since it had the same tough, thick appearance, and was accordingly incised. Urine of ammoniacal odor immediately welled out. Thinking that a very large diverticulum of the bladder had been opened (although it lay to the outer side of the sac) a sound was passed per urethra into the bladder. The finger in the supposed diverticulum was unable to palpate the sound in the bladder. Dissection proceeded, and it became evident that the ureter was dealt with. It descended to the depths of the scrotum in a single loop and returned to its insertion

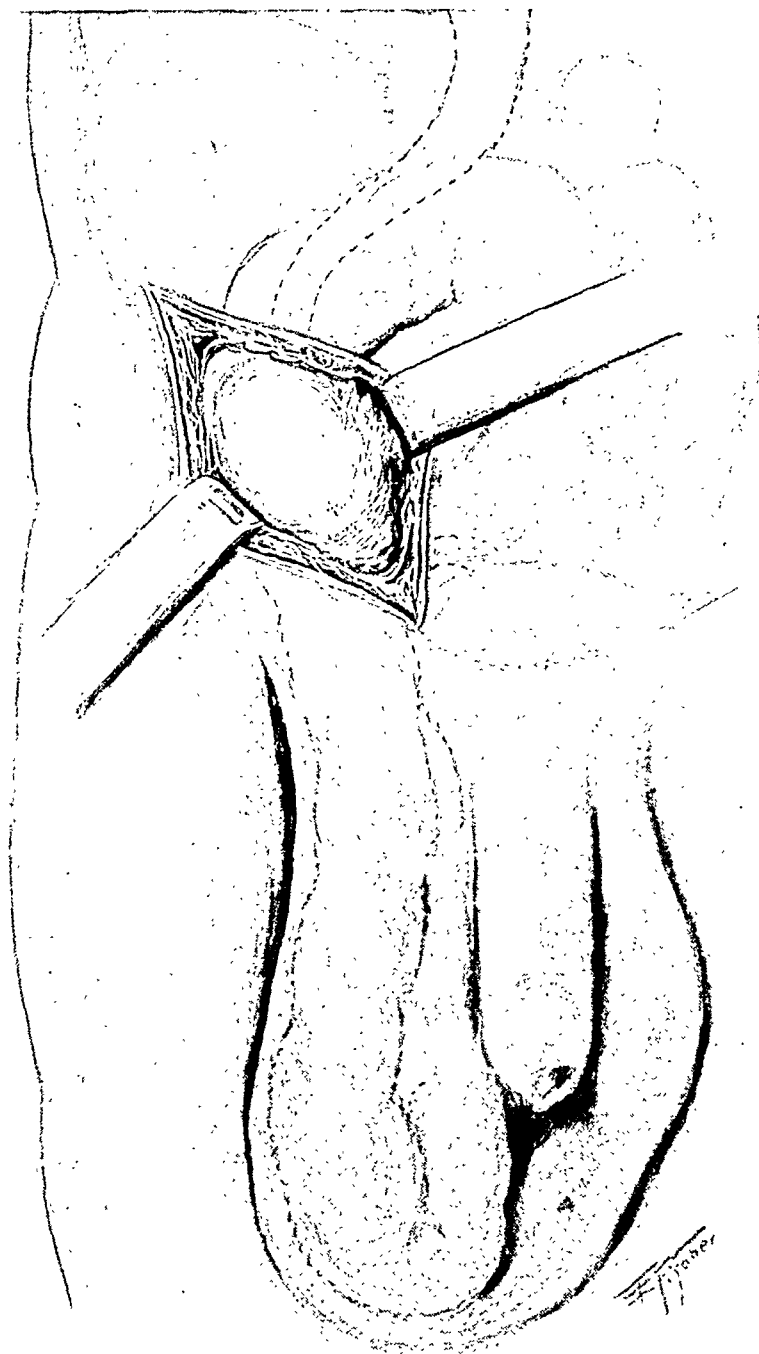


FIG. 1.—Hernial sac exposed.

in the bladder, which was not implicated. About ten inches of extraabdominal ureter was thus dissected with difficulty from the peritoneum forming the posterior wall of the sac, to which it cleaved tenaciously. The ureter was about one inch in diameter and its wall was about one-eighth inch thick.

Since the ureter had been jeopardized by this dissection it was deemed necessary to remove the kidney, and this was speedily done by continuing the inguinal incision upward into the right loin. The pelvis of the kidney was distended to about three times its normal size, and the kidney itself was displaced downward about one and one-half inches and appeared hard and atrophic. The entire ureter was removed with the kidney, its lower end being tied near the bladder. The muscles and fasciæ were closed in layers, a cigarette drain provided for the loin, and an indwelling catheter for the bladder. Hypodermoclysis caused prompt rally from a moderate shock. Convalescence was marked by a severe bronchitis, an orchitis, cystitis, and limited infection of the wound. The latter cleared under Dakin's treatment, while the bladder condition improved with mercurochrome instillations. There was no urethral or prostatic obstruction.

Six weeks after operation patient was discharged with a phthalein output of 40 per cent., no evidence of recurrence of hernia, and in good general condition. Unfortunately, the patient refused cystoscopic examination.

Discussion.—This case is of particular interest not so much for its presenting a sliding hernia of the ureter, but for its presenting a sliding hernia of the ureter alone. How is it possible to explain the failure of the cæcum, ascending colon or other organs to take part in the "sliding" feature of the mechanism? If a hernia of such size was able to "pull down" the ureter, according to the theory of Moschcowitz, why should it not have pulled down other adjacent extraperitoneal organs?

It is believed that these questions can only be answered by classifying this hernia as a congenital anomaly.

According to Piersol ("Human Anatomy," Lippincott, Philadelphia), the genito-inguinal ligament by means of which the testicle descends into the scrotum, is attached to the ligament of the testis through the intermediary of the Wolffian duct. The ureter, which develops as a stalk from the Wolffian duct during the fourth week of fetal life, lies anteriorly and to the outer side of the Wolffian duct and the two ligaments guiding the descent of the testicle. It is, therefore, in a position to be dragged down with these structures should differentiation fail to occur early enough, or should it adhere to them.

The Wolffian duct at a later period becomes drawn down to form the epididymis, vas deferens, and seminal vesicle. The ureter has occasionally been observed to have been drawn down also and to terminate in the vas deferens or the seminal vesicle (Piersol).

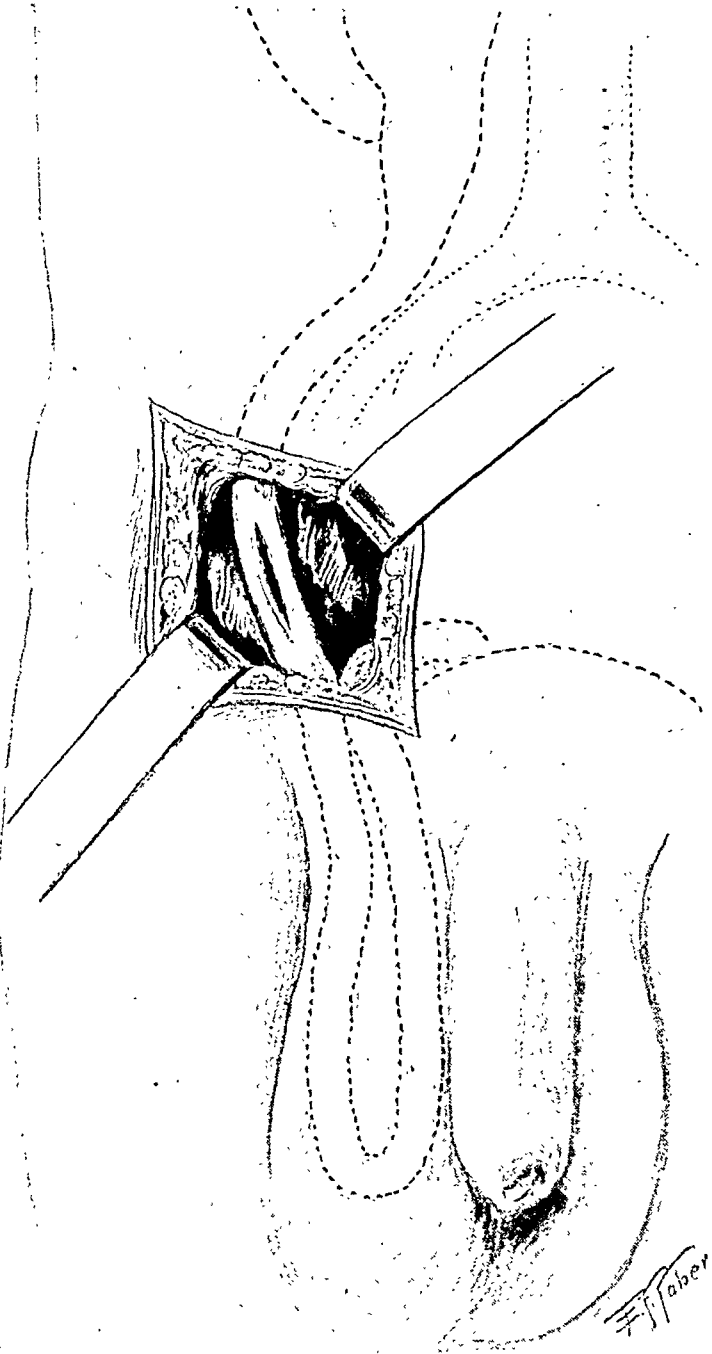


FIG. 2.—Sac and contents removed. Ureter in position.

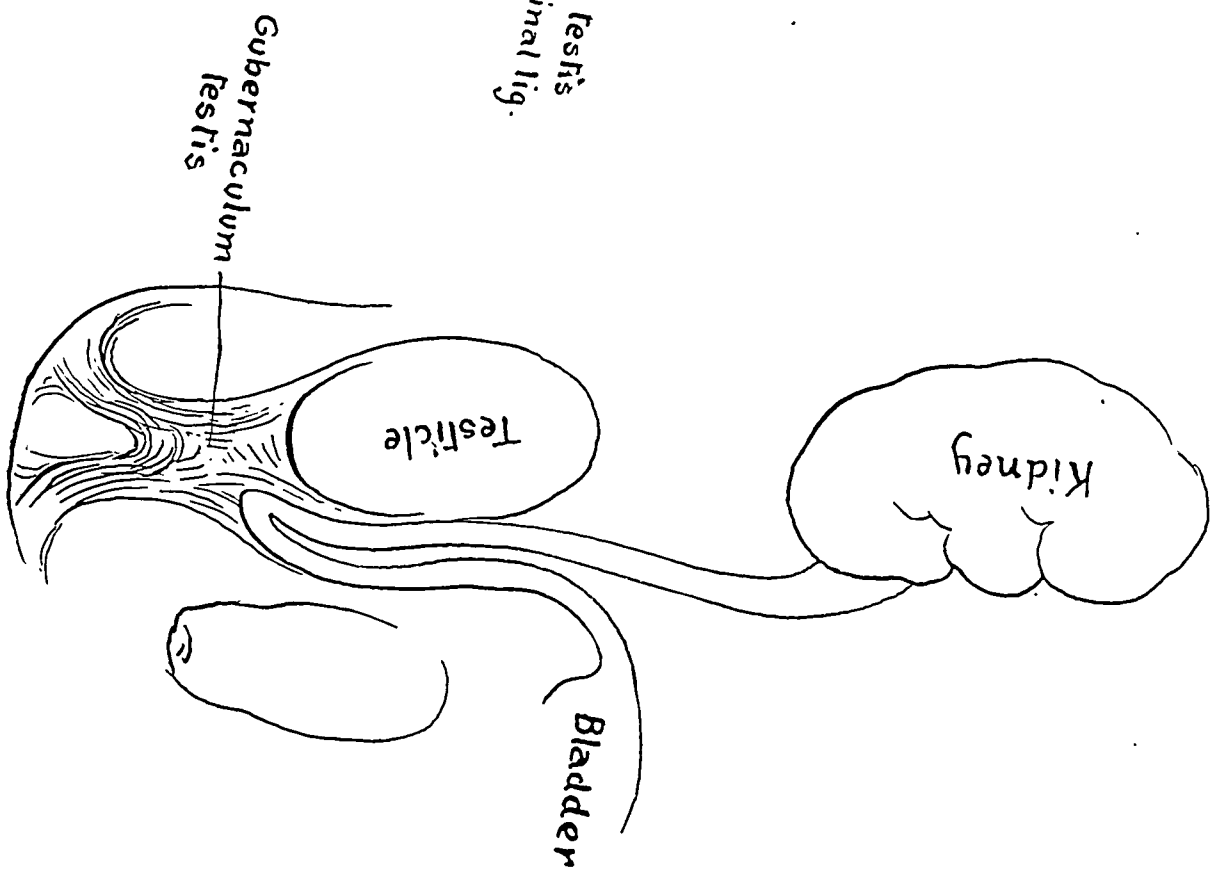
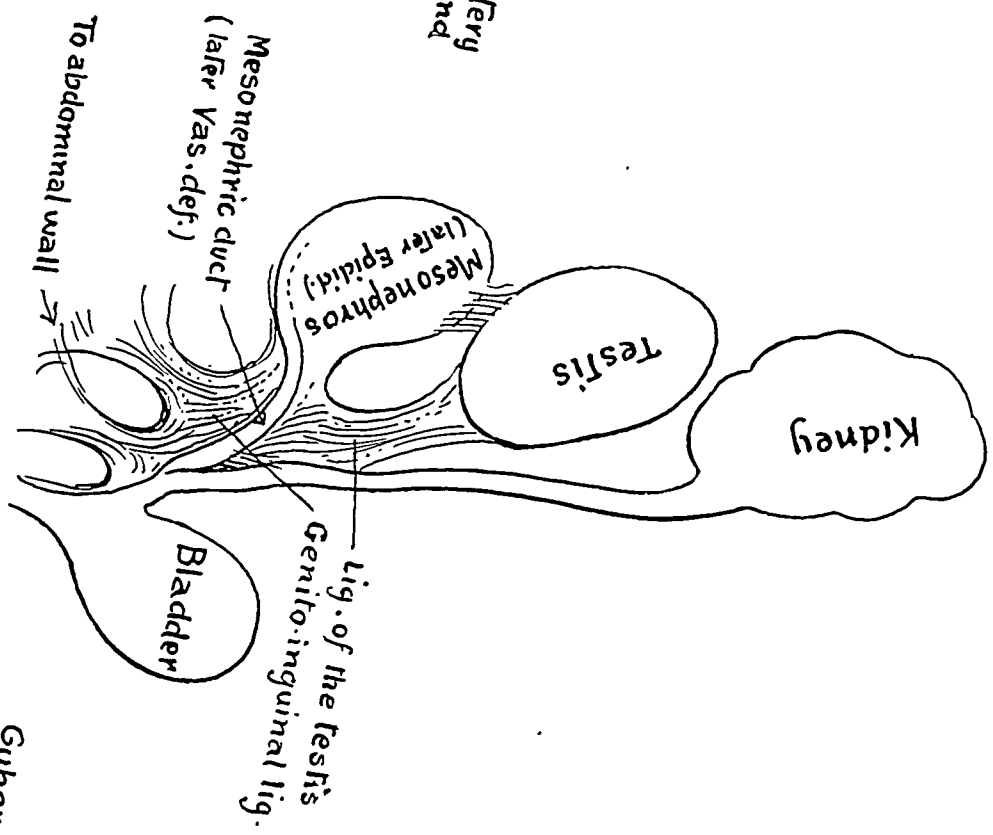
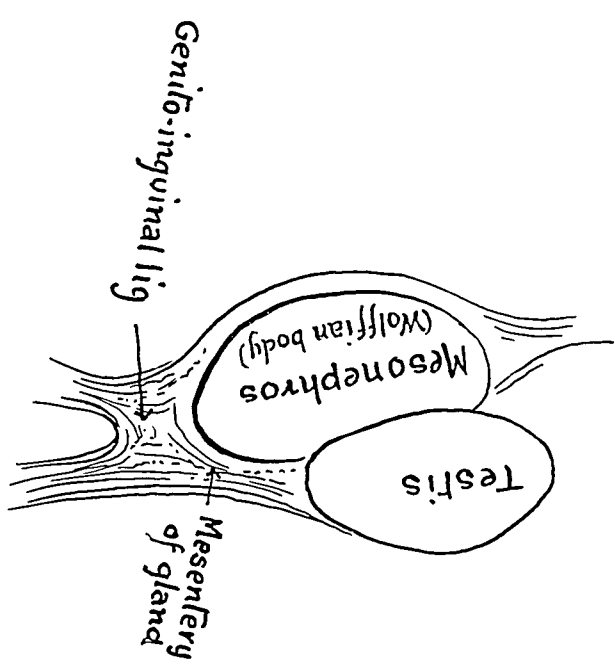


Fig. 3.—Embryonic development of prolapsed ureter.

If this speculation is acceptable, it furnishes evidence in the moot question as to the congenital or acquired nature of all hernial sacs.

The interesting observation of MacLellan (*Surg., Gyn. and Obstet.*, 29, 387, October, 1919) lends additional support to the theory of congenital development. MacLellan found undisputed adrenal rests imbedded in the sacs of six hernias in a series of 700 consecutive hernio-



FIG. 4.—Specimen removed.

tomies in children. These small accessory suprarenals are thought to arise from the atrophic tubules of the Wolffian body (Piersol). It is not unreasonable to suppose that a structure so closely related as the primitive ureter might travel as far and as promiscuously.

CONCLUSIONS

1. A second case of prolapse of the ureter through the inguinal canal is reported.
2. The evidence presented favors the theory of congenital formation of hernial sacs.

DISLOCATIONS OF THE SEMILUNAR CARPAL BONE

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AN apology should be made probably for reporting one case of any kind. If the report of that case stimulates an interest in the subject, and a careful study of future cases of similar injuries prove that the present experience is erroneous in that the type is not as rare as we think it is, the report will have served a good purpose. Such is the hope of this contribution.

During the past ten years at the Surgical Clinic at Touro Infirmary, we have seen only one *uncomplicated* case of *dislocation* of the semilunar carpal bone. This may be due to one of several factors.

Dislocations of the carpal bones probably will always form a small part of the experience of the individual, as has proved the case in our experience, but since they must be considered in all injuries of the wrist, the possibility must be borne in mind.

Stimson in his classic work states that "the X-rays have shown that dislocation of the semilunar bone, either alone or in combination with fracture of the scaphoid, is far from uncommon and is second in frequency to fractures of the scaphoid." He further states: "Of each of these there are many clear uncomplicated cases."

One of the most frequent types of cases which we are called on to treat is injuries to the wrist. Fractures of the base of the radius form by far the greatest number of these cases, but in making the examination it is necessary to bear in mind the many other conditions which might result from the violence. Each in turn must be eliminated. Each type requires its special treatment. In the near future an analysis of our experiences with wrist injuries will be published.

Among the possible conditions to be considered it is necessary to give attention to "sprains," traumatic tenosynovitis, fracture or dislocations of the carpal bones, individually or collectively. The possible injuries to the wrist can only be eliminated by a systematic examination, which takes into account the anatomic landmarks as well as the probable reason for each symptom and sign which is evident.

The casual examination upon which a diagnosis of sprain is made cannot be justified in the light of properly interpreted X-ray pictures nor by the disabling results which follow in their wake. Reference to clinical experience and to the work of Ross and Stewart on Sprains Fractures will convince the most sceptical of the infrequency of true sprains. They tabulated in 1911 the results of observations of 145 cases; twenty-five involved the wrist. Of the twenty-five, seven proved to be

cases of old "sprain fracture of the scaphoid, one case of fracture of the os magnum, one of fracture of the lower end of the radius, scaphoid and semilunar in the same wrist. There is not one of the semilunar alone." *"All of these cases suffered as a result of either being treated as a sprain or receiving no treatment."*

These authors performed a series of fifteen experiments on animals in which a pulling force, hyperextension and forces in other directions was placed on joints in such a way as to increase the range of motion beyond the normal. In every instance save one the bone gave way. The tendons and ligaments remained intact in most instances. They concluded: "These experiments show how the frequent occurrence of sprain fractures is possible and how rupture of tendons and ligament as a part of the pathology of so-called sprains is impossible."

The experience which has been obtained during the past ten years at the clinic has confirmed these observations of Ross and Stewart. *Taking all joints into consideration where a careful physical examination as well as an X-ray examination was made, we have found very few instances where there was not more*



FIG. 1 (19514).—Dislocated semilunar carpal

to explain the disability than an unseen but simply suspected tear of ligaments. Of course, for a time, until the patient ceases to feel that pain is part of his misfortune, he will be pacified. When the pain persists he wants to know why. It will be necessary to explain unless one avoids the diagnosis of sprain behind which to hide.

There may be some who will say that in cases where there is no disturbance of anatomic landmarks, with only pain and some swelling, a sprain will be sufficient diagnosis. They are too easily satisfied. The pain which follows an injury is associated with limitation of motion, which is nature's defensive mechanism, the production of muscular con-

traction. Would it not seem more plausible to believe that the immediate swelling about a joint is the result of an outpouring of synovial fluid in the joint as well as in the tendon sheaths? Therefore one would expect and does actually find frequently in these injuries about the wrist, in which the landmarks are intact and in which radiologic examination is negative, that there is a localized swelling just below the base of the radius and that the pain accompanying these injuries is exaggerated by palmar flexion. Traumatic tenosynovitis is not a rare occurrence and justifies its proper treatment, which consists in immobilization of the forearm and wrist, with the wrist in dorsiflexion.

In 1917 I discussed the subject of sprains in *The New Orleans Medical and Surgical Journal*, vol. lxxix, No. 9. The conclusions arrived at at that time have been confirmed by increased experience.

Before proceeding with a discussion of the possible injuries of the wrist, let us briefly review the anatomy of this joint. "Piersol's Anatomy" has been largely drawn upon for this purpose.

The capsular ligament, which is subdivided into the external lateral, internal lateral, anterior and posterior ligaments extends from the base of the radius and styloid of the ulna down to the level of the metacarpals. Within this capsule are three articulations—the radiocarpal, intracarpal, and carpo-metacarpal. The lower end of the radius articulates with the scaphoid and semilunar. These two bones occupy almost completely the articular portion of the base of the radius. It must be remembered that the lower end of the radius presents an overhanging lip or ridge which limits dorsiflexion of the wrist. *It must be remembered, particularly when we are considering injuries to the wrist, that limitation of palmar and dorsiflexion is due to some mechanical alteration of the normal relationship of the carpal bone and the base of the radius.* The displacement of any one of

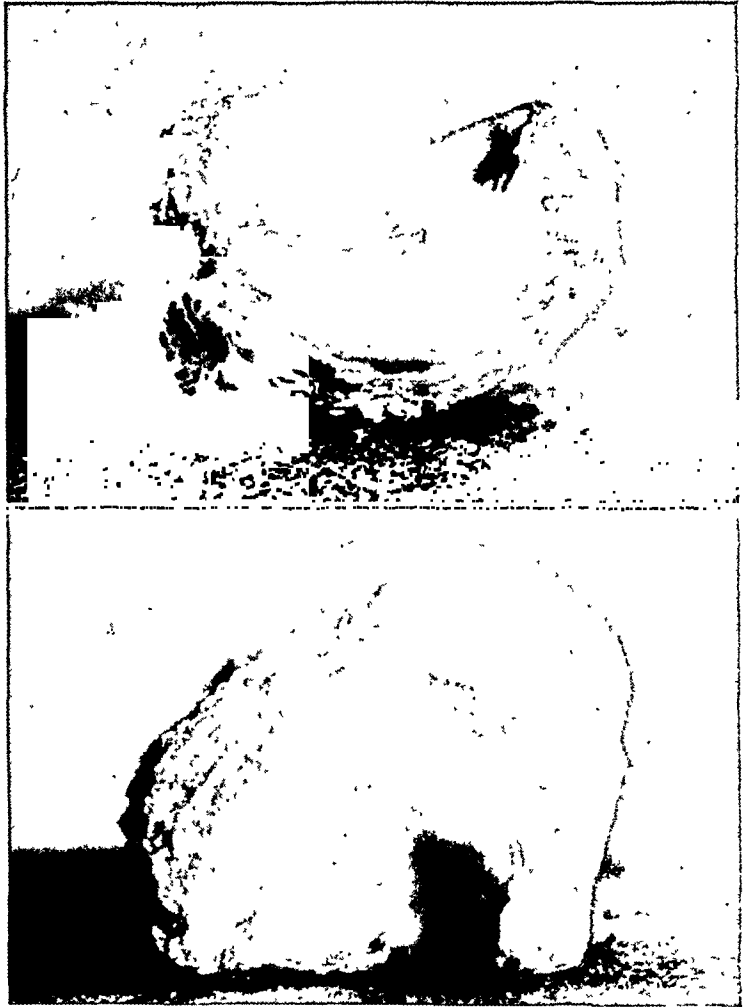


FIG. 2 —The removed carpal bone.

these, due either to fracture or a dislocation of one of the carpals, or a fracture of the base of the radius, with a displacement of the base of the radius causing a change in the axis of the lower fragment, will interfere with normal motion in palmar and dorsiflexion. From the foregoing we are reminded that such limitation of motion is suggestive of more than a simple sprain. *We should be on the alert* for the possible mechanical causes of such limitation.

The carpal bones of the first row are united by interosseous ligaments. A synovial membrane covering the carpo-radial joint, which extends over



FIG. 3.—Result after removal of semilunar carpal bone.

the proximal ends of the first row, shuts off this joint from the intracarpal joint. The scaphoid is attached to the semilunar much less tightly than is the cuneiform, so that there is considerable motion between the scaphoid and the semilunar. The scaphoid, besides sliding in various directions on the semilunar, can move to some degree independent of the rest of the first row. The scaphoid, semilunar, and the cuneiform have been compared to a meniscus subdividing the joint. No muscle of the forearm is inserted into them.

These bones are never moved directly, but change their position

under pressure of the distal row, which is pulled against it by the muscles moving them (Piersol).

The greatest number of wrist injuries result from a fall on the outstretched hand. The exaggerated dorsiflexion which results causes a stretching of the anterior portion of the capsule of the wrist, as well as an impaction of the scaphoid and semilunar against the base of the radius. This latter effect is due to the weight of the body acting through the base of the radius, being transmitted thereby to the semilunar and scaphoid. The resistance is furnished by the trapezoid, trapezium, and os magnum.

Experiment and clinical observations have shown that the ligaments do not tear independent of the bony prominences; therefore fracture of the base of the radius is the most frequent injury. The mechanism of this injury has been clearly described by Dr. Lewis Stephen Pilcher in a recent monograph. Reference to this will be profitable.

The question often arises, why the comparative infrequency of dislocations? Aside from the strong ligamentous attachments it would seem that the overhanging lip of the radius is the most important agent which prevent such an accident. Dislocation of a carpal bone is associated with a deformity, which is at times not easy to differentiate from fracture of the base of the radius.

It is always necessary to consider anatomic landmarks about the wrist when making an examination. Normally we expect to find the styloid of the radius on a lower plane than the styloid of the ulna. If the styloid of the radius rises to the level of the ulna styloid it may be definitely stated that there is a fracture of the base of the radius, with an upward displacement of the distal fragment, or impaction of the shaft into the distal fragments. There is usually a lateral deviation of the hand to the radial side,

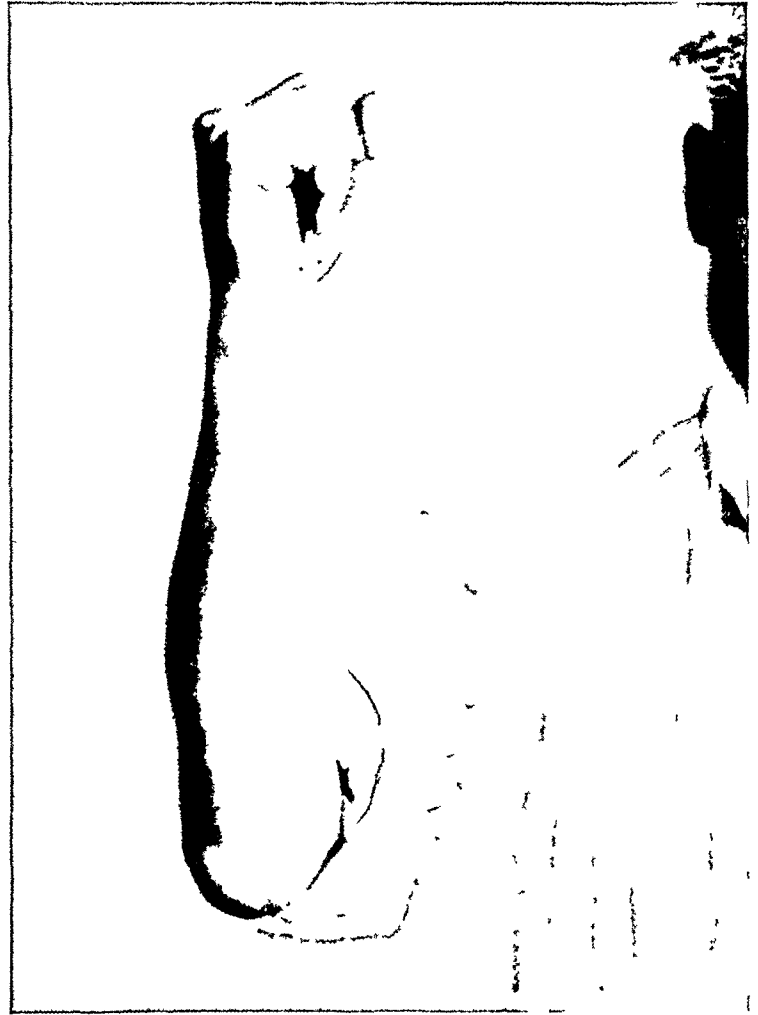


FIG 4.—Result after removal of semilunar carpal bone.

with a corresponding prominence of the ulna styloid. The limitation of function, particularly palmar and dorsiflexion, is marked. In this last-named sign there is a marked similarity between a dislocation of the carpal semilunar and fracture of the base of the radius. The limitation of function in the former is due to a mechanical interference, the presence of the dislocated bone in front of the articular surface of the radius. The fact that dislocations of the semilunar carpal result from forcible dorsiflexion (as cranking an automobile) makes it imperative to subject to radiographic examinations injuries other than, and as well as, injuries resulting in deformities of the wrist.

The diagnosis probably cannot be made with certainty without the aid of properly taken radiograms.

The one thing which can be said after finding that the prominences bear their normal relationship to each other is that there must be a mechanical interference such as would be caused by the dislocation or fractured carpal bone.

In regard to the value of the X-ray one must consider the peculiarities which carpal bones may present; pictures must be taken in several planes. Stereoscopic radiograms will probably be of great service.

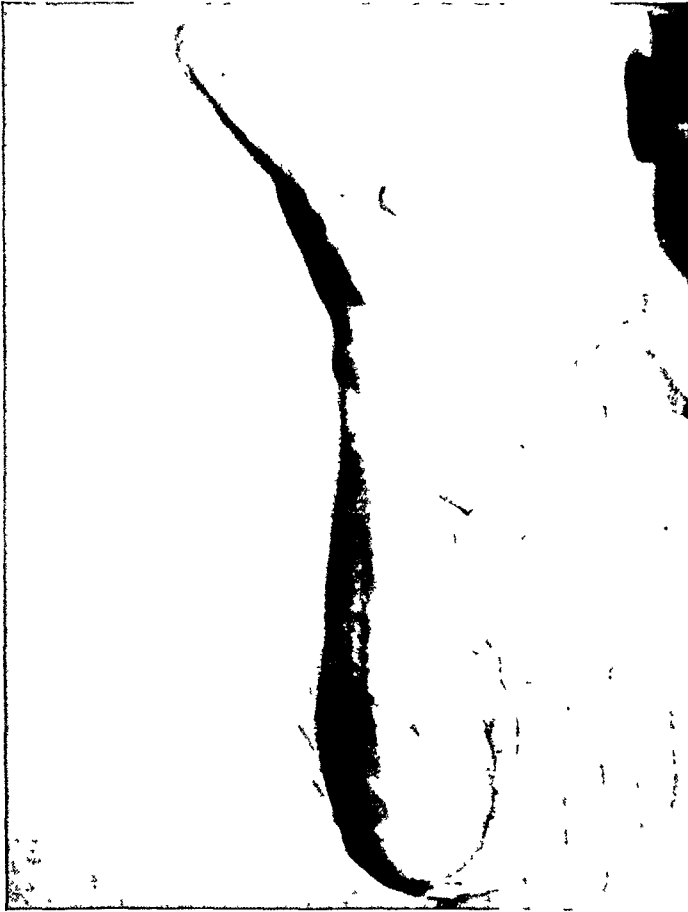


FIG. 5.—Result after removal of semilunar carpal bone.

Dislocations here like in other locations are either recent or ancient.

In arriving at a decision to adopt a particular type of treatment we should be guided by certain principles: (1) Can we completely reduce the dislocated bone: thereby restoring the normal functions? (2) If reduction cannot be effected by manipulation, will removal permanently interfere with the function of the joint?

In recent cases at times it is possible by manipulation to reduce the dislocation.

This was well illustrated in a recent experience. The patient had a fracture of the scaphoid, with incomplete dislocation

of one of the fragments, and under an anæsthetic the wrist was manipulated and reduction was effected.

In old unreduced dislocations it is highly probable that reduction cannot be effected. The space normally occupied by the dislocated bone probably becomes more or less filled by tissue of new formation or the remaining carpal bones become more closely approximated, preventing complete reduction. Incomplete reduction will result in permanent limitation of motion.

If the function of the first row of the carpal bones is as Piersol has

DISLOCATIONS OF THE SEMILUNAR CARPAL BONE

suggested, that of a meniscus, the same treatment can be applied here as in a dislocated cartilage in the knee—that is, removal.

Good function is restored after removal, as will be shown by the accompanying photographs of the case herein reported; therefore, it would seem that surgical removal is the only logical procedure.

The method of approach to the carpal bones offers many difficulties, if one would avoid injury to important structures. The incision used in the case reported here was that suggested by Dr. James Thompson, of Galveston, for exposing the lower end of the radius. A linear incision beginning at the radial styloid and extending upward for about two inches, the supinator longus was retracted to the radial side; radial artery and nerve were retracted with the superficial flexors to the ulna side; the pronator quadratus was exposed, after which the anterior carpo-radial ligament was incised, thus exposing the first row of carpal bones. The dislocated semilunar came readily into view. The deep flexor tendons were seen superimposed on the dislocated carpal bone. By cutting the interosseous ligament the semilunar was mobilized completely and removed. The wound was closed without drainage and the patient encouraged to move the hand as soon as he roused from the anæsthetic.

The principle of immediate mobilization of joints, which was suggested by Willems, and which has been hailed as the most valuable contribution to the surgery of joints in recent years, is applicable here.

CASE I.—J. P. T., male, aged forty-four years, laborer. Twelve weeks ago, while cranking a Ford automobile, the engine backfired, and as a result of this his wrist was injured. He was unconscious for a few minutes, and when consciousness returned he sought the service of a doctor, who believing it to be a fracture of the base of the radius manipulated and put on splints, which he allowed to remain on for several weeks. The pain in the wrist persisted, and even after the dressing was removed by the doctor, there was marked limitation of motion in the wrist and fingers. At the present time his chief complaint is pain in the wrist and fingers, and inability to flex the wrist or make a fist.

Examination.—There is a slight enlargement of the right wrist as compared with the left, and a distinct prominence on the palmar side of the wrist. This prominence is hard, there is a normal lateral mobility at the wrist, but flexion is limited to about 10 degrees; dorsiflexion is less limited than palmar flexion; he has almost complete loss of grip; there is a glossiness of fingers, and atrophy of the muscles of the hand and fingers. The intraphalangeal joints of all the fingers have very little motion. X-ray was requested, because it was thought that the patient was suffering from an impacted fracture of the base of the radius. The X-ray, however, showed very clearly a dislocation of the semilunar carpal bone. The patient was advised to be operated; this advice was accepted, and he was operated at the Flint Goodridge Hospital by Dr. Isidore Cohn, assisted by Dr. Paul G. Lacroix. The details of

the operation having been described in the first part of the paper it is unnecessary to repeat them. The X-ray photograph of the removed carpal bone and photographs of the patient at the present time accompany the paper.

Present condition of the patient is as follows: The contour of the wrist is practically normal; there is only a slight limitation of palmar flexion; his grip has returned, there is very much glossiness, and as a result of the use of the hand there seems to be a gradual return of the normal appearance of the hand and fingers.

SUMMARY

1. Careful examination will reveal that dislocations and fractures of the carpal bones are more frequent than present records indicate.
2. Limitation of palmar flexion is due to mechanical interference, caused by fractures or dislocations of carpal bones or fracture of the base of the radius.
3. Recent dislocations of carpal bones can be reduced by manipulation.
4. Old unreduced cases had best be operated, with removal of the dislocated bone.
5. Removal of the semilunar causes an interference with good function at the wrist.
6. The approach should be made in such a way as to do as little damage to important structures as possible.
7. Immediate mobilization of the joint is advisable.

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INJURY TO THE BILE DUCTS AND METHODS OF REPAIR*

By HORATIO B. SWEETSER, M.D.

OF MINNEAPOLIS, MINN.

INTERFERENCE with the normal flow of bile into the intestine is one of the most serious mishaps which may befall a patient. This is so, because, on the one hand, if the normal flow is not reëstablished the patient will more or less quickly die, and, on the other, the successful accomplishment of the proper return flow is extremely difficult and sometimes practically impossible.

Leaving out cases due to obstruction by pressure of malignant tumors, this interference with the normal flow of bile is due (1) to a stenosis of the ducts following deep ulceration, (2) pressure by adhesions, and (3) division of the common duct (intentional or accidental) during the operation of cholecystectomy.

That such accidents are not uncommon may be inferred from the number of cases reported in which reconstruction has been attempted. It is fair to assume that there must be very many unreported cases, for it is a well-recognized fact that none of us is prone to publish his disasters, especially if they seem due to his own errors of technic. It is also fairly certain that many such accidents will occur in the future, probably many more than in the past, due to the fact that cholecystectomy is largely supplanting cholecystostomy as the popular operation for gall-bladder disorders. It is, therefore, of extreme importance that all cases of attempted repair should be reported, the unsuccessful as well as the successful ones, so that a satisfactory and efficient technic may be developed for their repair. Eliot,¹ in an exhaustive analysis of the cases of stenosis and the methods of reconstruction, collected 190 cases, forty-five being from the Mayo clinic. Since then, now over three years, I have been able to find the reports of only three additional cases. Eliot's report shows that this accident has occurred more than once in the hands of the most skilful and experienced surgeons; and this is not to be wondered at when one considers the difficult pathology and especially the abnormal anatomy often encountered in the right hypochondriac region. Eisendrath,² in a well-illustrated article, has called attention to the anatomical abnormalities of the bile ducts and hepatic and cystic arteries (Fig. 1). In twenty-five of the hundred cases examined, the relationship of the cystic to the hepatic and common ducts was different from that given in the text-books; in seventeen the hepatic and cystic ducts were parallel and closely bound together. Behrend,³ also, published a similar article, laying particular stress on the presence of abnormal adhesions, congenital and acquired.

It is of great importance, therefore, if we wish to keep out of trouble,

* Read before the Hennepin County Medical Society, Minneapolis, Minn., September 7, 1920, and the West Wisconsin District Medical Society, Eau Claire, Wis., November 10, 1920.

always to bear in mind the possibility of the presence of such abnormalities when operating in this area. In one of the two cases herewith reported, the cystic and common ducts were parallel and bound together, both being cut across under the impression that I was dealing only with the cystic duct. This case is of no value as regards method of reconstruction, as the patient died in less than seventy-two hours from septic peritonitis. In the second case the stenosis was not complete and was due to an inflammation of the common duct, which was present before the operation, and made worse, I think, by the presence of the drainage tube.



FIG. 1.—Anomalies of the bile ducts and blood-vessels. (Copied from Eisendrath, *Jour. Amer. Med. Assoc.*, vol. lxxi, September 14, 1918, pp. 804-866.)

CASE I.—Mrs. L., aged forty-eight years, married, admitted to the hospital August 29, 1916. For five years she had suffered from repeated attacks of gall-stone colic. The present attack began suddenly and she has since continued sick. When admitted she was jaundiced, urine very dark and scanty, passing only 10 oz. in the first twenty-four hours. Stools were light brown, vomiting persistent, loss of flesh considerable. After a week her condition improved so much that it was considered safe to operate. The very serious mistake was made of attempting to do more than removal of the stones with drainage, for the difficulties we got into prolonged the operation unduly and contaminated the peritoneum widely. At the operation many dense adhesions were encountered before the ducts were exposed. After the gall-bladder was removed, stones were discovered and removed from the hepatic ducts. The hepatic and common ducts were united behind and a tube put in for

drainage. Bile flowed freely from the wound, but the patient complained of great pain, and after twenty-four hours developed symptoms of sepsis with continuous vomiting, increasing pulse-rate and fever, and died in about sixty hours. No autopsy.

CASE II.—Mrs. C. E. T., admitted January 23, 1918, and referred by Dr. Oscar Oberg, Sioux Rapids, Iowa. Thirty-six years of age, married twelve years, never pregnant. Menses began at eleven years. Family history: Both parents died of cancer—father at sixty five, mother at fifty—but her brothers and sisters are all living and in good health.

Personal History.—The only acute illnesses she has had were measles and whooping cough when a child. For the past eight years she has suffered more or less with attacks of gastric disturbance, and during the past two years these have been accompanied with pain, starting in the right epigastrium and radiating to the back and right shoulder blade. A year ago she was jaundiced following an attack, and a few months ago a soreness developed in the right epigastrium which lasted for several weeks but gradually disappeared. Since then she has lost fifty pounds in weight. The present attack began six days ago with severe pain and continuous vomiting lasting for several hours and requiring a hypodermic of morphine. The following day jaundice appeared with clay-colored stools and bile-stained urine.

Examination.—Fairly stout; mildly jaundiced; tender over gall-bladder, greater curvature of stomach and appendix. Skiagram was negative as to gall-stones, but no other comment was made as to the X-ray findings.

First Operation.—On January 26, 1918, the gall-bladder was removed and drainage tube sewed in cystic duct. The bladder was small with very thick walls, and adherent to stomach and duodenum. It contained many stones, one encysted in a pocket in the antrum, and one in the cystic duct, but no bile. No mention is made of probe being passed through duct to duodenum. Examination of specimen showed no evidence that the common duct had been injured. Following operation the flow of bile was profuse. The tube was removed on the ninth day, but the fistula continued to run, and a note made on the twenty-fifth day, February 20th, when she left the hospital, stated that the flow was profuse. On the twenty-first day the stool was noted as highly colored, but when she left it was clay colored. The fistula remained open for two months, to March 25th, its closure being promptly followed by severe pain and some jaundice. After two days it reopened with relief of symptoms, and continued to drain for five weeks, to April 28th, when it again closed and stayed closed up to the time of the second operation. On May 4, 1918, her doctor wrote that the drainage was very slight, that "there was plenty of bile in the stools, and that she was much better." For three weeks following the closure the skin remained clear, but then the jaundice returned and persisted in varying degree. Her appetite, however, was good and food did not distress her. The gall-bladder area ached and was tender, but there was no pronounced pain at any time.

Patient returned to hospital November 30, 1918. At that time the

skin and conjunctivæ were quite yellow in color, but the stools were brown and showed bile reaction to laboratory test.

Second Operation.—December 9, 1918, the abdomen was opened through the old scar. The stomach, duodenum and omentum were strongly adherent to the parietal peritoneum and to the liver, and the adhesions were most dense in the depth of the wound, where eventu-

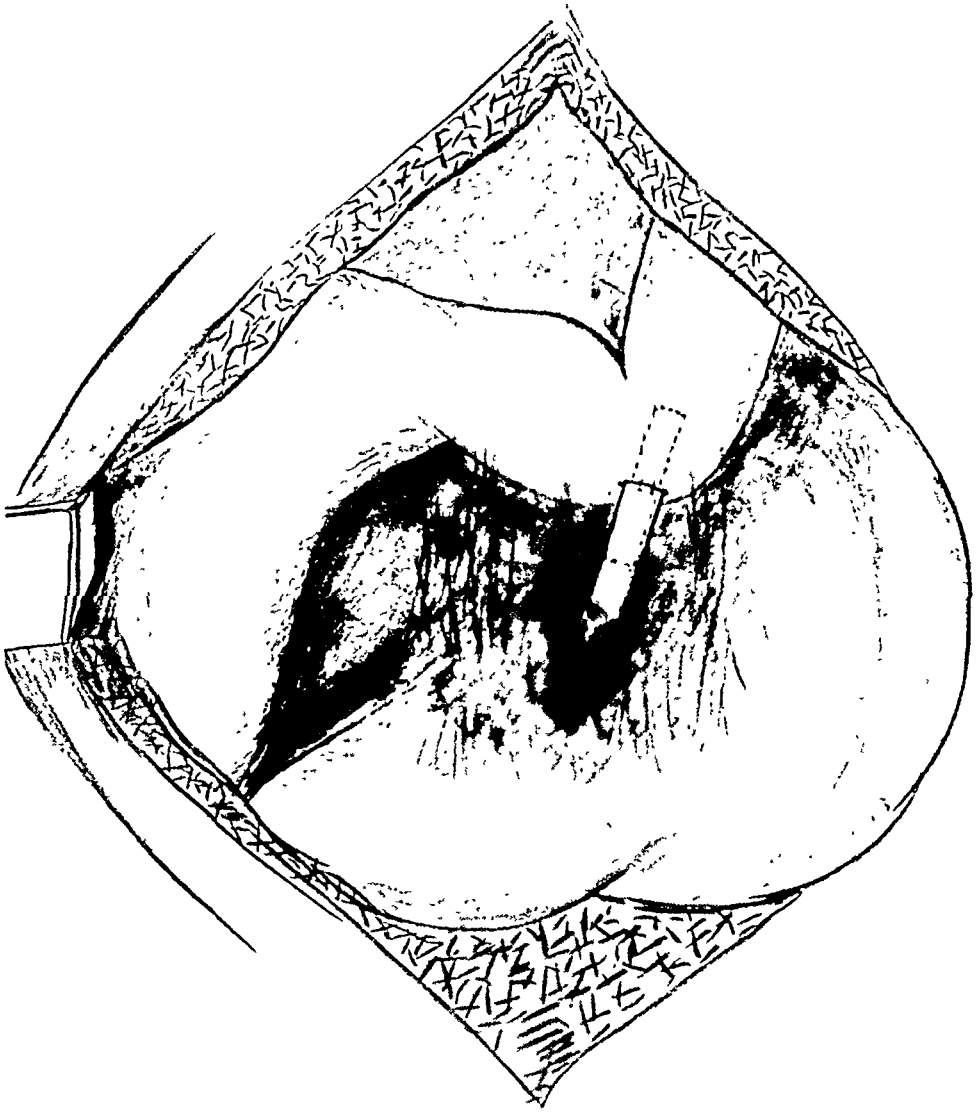


FIG. 2.—Stump of duct freed from adhesions. Duodenum below.

ally the cystic duct was found. A probe passed readily upward, but could not be passed downward to the duodenum. The foramen of Winslow was open, the common duct was not dilated and was not identified. This dissection consumed much time, and the patient was feeling the effects of the prolonged operation. Therefore, and because the presence of bile in the stools showed that the common duct was not entirely closed, it was decided to put a drain in the duct and close the wound to

INJURY TO BILE DUCTS

it, in the hope that the release of the dense adhesions might allow of further opening of the duct. Patient reacted well and passed brown stools for ten days. However, on the sixth post-operative day there suddenly developed pain, vomiting, fever, rapid pulse, and marked tympanites which continued for four days, and which were relieved by repeated doses of pituitrin. The leucocyte count was 31,000, but no

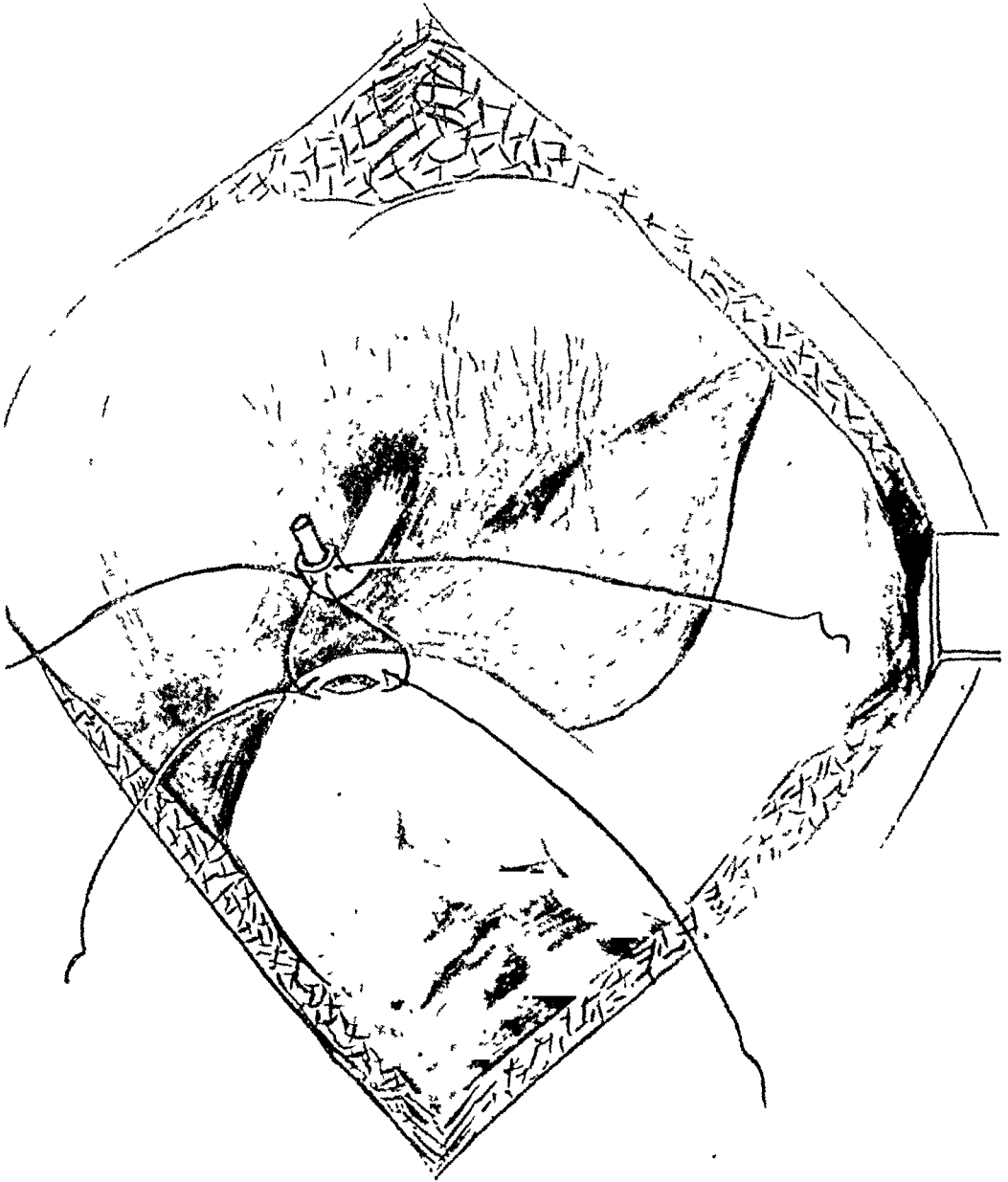


FIG. 3.—Duct containing rubber tube; opening in duodenum; sutures placed.

abscess formed. Her condition then gradually improved, she was out of bed on the eighteenth day, and left the hospital in fairly good condition on January 26, 1919, seven weeks after operation. But the stools contained no bile, and the fistula was draining freely. Closure of the fistula in the latter part of April was promptly followed by discomfort and jaundice. She returned to the hospital for the third time on April 29, 1919. At this time she was moderately jaundiced, but the tempera-

ture was normal, pulse-rate 60 to 80, and she had gained in weight and strength. The urine contained much bile, and the stools were clay colored. Fistula was closed.

Third Operation.—May 1, 1919, incision was medial to the old scar. The same dense adhesions were encountered as at the second operation, and had to be dissected free with knife and scissors. This was a difficult and slow process and quite disconcerting. Finally the cystic duct

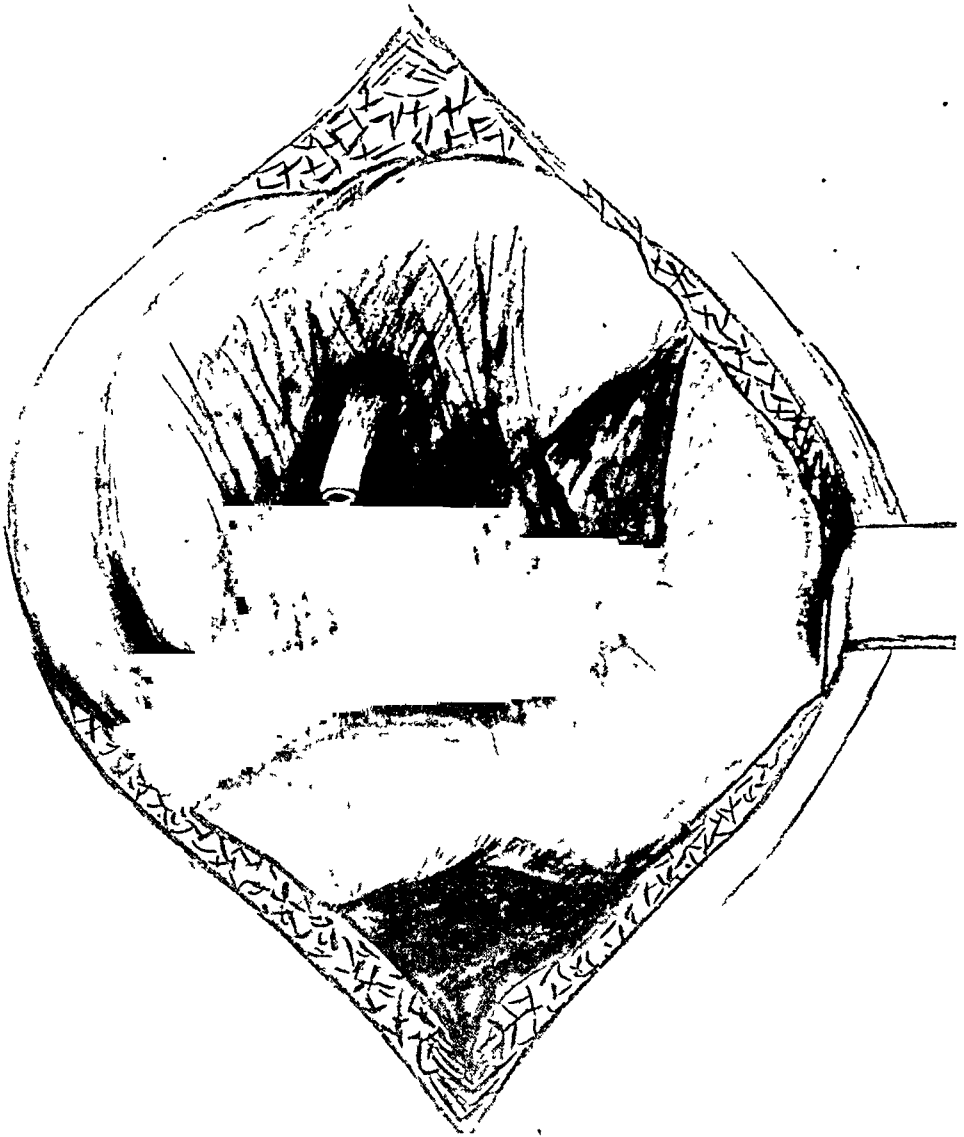


FIG 4 —Anastomosis completed, rubber tube indicated by dotted line.

was found by the flow of bile and was freed to the extent of about a quarter of an inch. It emerged from the under surface of the liver, and was about the size of an ordinary lead pencil. No effort was made to identify the common duct, and it was not seen at all. The duodenum was mobilized so that it could be easily approximated to the duct. Two linen stitches were then passed through the duodenum one-quarter of an

inch apart, and tied. A Number 17 catheter was passed an inch into the duct and held in place by a chromic gut suture. The duodenum was then opened between the stay stitches, directly through all coats, no effort being made to form a valve. The other end of the tube, about two inches long, was inserted into the duodenal opening. The stay stitches were then passed through the posterior wall of the duct, the duct and duodenal opening closely approximated, and the stay stitches tied to each other over the tube. The posterior edge of the duct was not sutured to the duodenal opening, but in front the two were sutured. The omentum was tucked around the joint, but not sutured. Rubber dam drains were carried down on either side of the anastomosis, and the abdomen closed. Time was two hours (Figs. 2, 3, and 4).

The following day the patient passed a normal-colored stool. There was considerable oozing from the wound, but a note on the fourth day recorded "a very slight amount of bile discharged from the wound, dark brown stools, and diminishing jaundice." On the seventh day urine contained only faint trace of bile; on this day also the stitches were removed to release a considerable amount of pus. During the eighth, ninth, and tenth days there was considerable discharge of bile, which, however, ceased on the twelfth day. Wound was practically healed at the end of three weeks, May 22nd, when the patient left the hospital. The tube was passed with stool on the fourteenth day. During the past winter she had a spell of sickness, and somewhat jaundiced, but this quickly passed away. A letter received from her physician in June, 1920, stated that she was in the very best of health, was taking long auto drives, could, and did, dance for four hours, and was able to eat a heavy-course dinner without the slightest discomfort; that there had been no return of the jaundice and that her stools were normal in every respect. A recent letter in August, 1920, stated that she has continued in the same condition of good health.

The methods devised for restoring the bile stream to the intestine have varied in order to meet the conditions encountered. Thus, if the common or hepatic duct is cut and the injury immediately discovered, it may be possible to approximate the divided ends of the duct successfully. This has been done a number of times, but some of the cases, successful at first, have failed later, because of stenosis at the point of union (twenty-three cases, four failures).

But in most cases the ends of the ducts are widely separated and the intervening space filled with dense scar tissue, so that such approximation is no longer possible; and then some other means must be employed to bridge the hiatus. The tissues which lend themselves best to a successful and permanent anastomosis are those which normally are bathed in bile, and consequently are immune to irritation by it. Such tissues are the mucous membrane of the ducts themselves and also the mucous membrane of the duodenum, jejunum and stomach. When it has been possible to approximate successfully these structures to the proximal end of the duct, the results have been permanent in

the majority of cases. The failures have been due either to stenosis at the point of union, or to an ascending cholangitis and abscesses of the liver from entrance of bowel contents into the ducts of the liver. To prevent this, in most cases the attempt has been made to form a valve at the point of anastomosis. If there is even only a very small stump of proximal duct, I think it will be found possible in almost every case to approximate either the duodenum, jejunum, or stomach to it so as to make a successful anastomosis. It was formerly thought that the stomach would not tolerate bile in any amount, but practical experience has proved this to be not so. In my case it was very easy to mobilize the duodenum. In several cases a flap from the stomach or duodenum has been used to form a new duct⁴ (Fig. 5), but such attempts require a nicety of technic and a prolongation of an already long operation in patients not likely to be good risks, and I fear would fail with most of us.

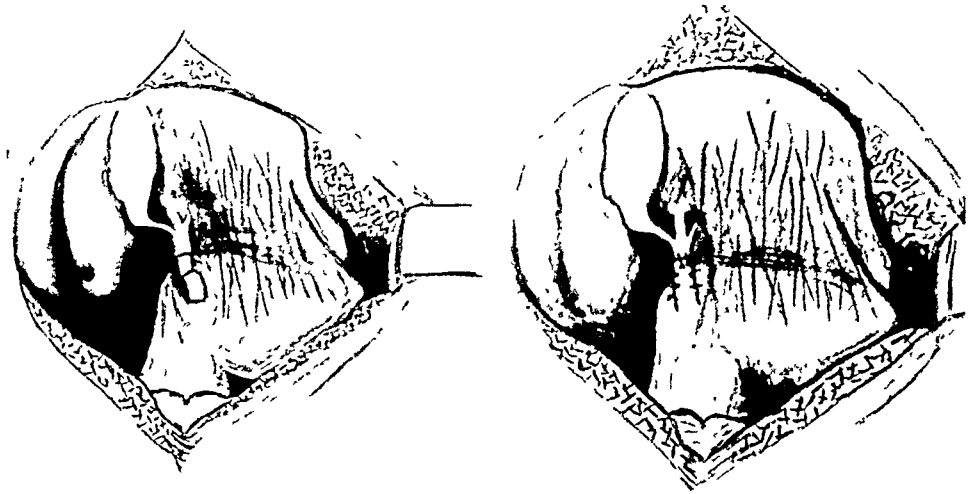


FIG. 5.—Flap taken from duodenum to form new bile duct. (Copied from Walton. *Surg. Gyn. and Obst.*, vol. xxi, September, 1914, p. 271.)

In all cases the anastomosis is made much easier if a temporary rubber tube is used as a splint, to be discharged later through the bowel.

But in a certain number of the cases it has apparently been impossible to approximate any part of the stomach or duodenum to the stump of the duct, and in these a number of ingenious methods have been devised to bridge the gap.

(a) The most successful of these has been the employment of a rubber tube, that portion of it occupying the gap being covered either by the contiguous peritoneum or by the omentum. This method was devised by A. G. Sullivan, in 1900,⁵ and he reported eight successful experiments on dogs, in which the tube was employed to bridge the gap between the duct and the duodenum. By 1912, twenty-two cases by this method were reported, and since then many more. There have been a number of successes, some of them apparently permanent, but many have eventually failed, either from stenosis or from an ascending cholangitis. Jenckel,⁶ of Heidelberg, bridged a gap of

eight centimetres, the patient being well at the end of four years. Mann,⁷ of our own society, reported a case in 1914, and I understand that this patient is still well. Since 1918 only three cases have been reported: one by Hagler,⁸ of St. Louis, which remained well for seven months and then died from cholangitis; one by Behrend,³ of New York, well after one year; and one by Merende,⁹ of Paris, well, but time not stated.

(b) Attempts have been made to bridge the gap by means of autogenous grafts, the tissues used being the appendix, pieces of fascia and sections of veins. These attempts, made on animals, have invariably failed, and I can find no case in which they have been used in the human. When veins were used, the lumen remained permeable for variable periods up to three months, but beyond this time stenosis occurred without exception. Shelton Horsley¹⁰ explains this by stating that there seems to be a biologic law of immunity which protects tissues normally in contact with irritating discharges from damage from them; and that other tissues invariably suffer damage when accidentally placed in contact with such discharges.

(c) The biliary fistulous tract has been used. Murphy¹¹ reported a case that functioned for eight months, but which eventually succumbed. All other similar attempts failed.

(d) A loop of jejunum has been used unsuccessfully, failure being due to ascending cholangitis and liver abscesses.

(e) In a few cases the hiatus was at the liver surface, with no duct available for anastomosis. In these an hepatostomy, or hepatoenterostomy, has been done, but with very meagre success.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held January 3, 1921

The President, DR. G. G. ROSS, in the Chair

INTUSSUSCEPTION

DR. T. TURNER THOMAS presented two infants: the first, a boy, when aged seven months, October 8, 1919, at about 8.30 A.M., was seized with severe pain in the abdomen. Began to vomit soon afterward and continued to do so. No bowel movements after pain began. At 9 P.M. Dr. M. V. Leoff was called and he in turn called in Dr. James H. McKee who diagnosed intussusception and advised immediate operation. This was begun about 2 A.M. at a private hospital, Doctor Leoff assisting. Right rectus incision with its centre about opposite the umbilicus exposed a mass which was found to be an intussusception. There was no evidence of adhesive inflammation, and by gentle traction on the entering portion of the small intestine and pressure on the distal end of the mass the intussusception was slowly reduced and proved to be of the ileocecal variety. The cæcum was considerably thickened and indurated from oedema. The abdominal wound was closed and dressed and supported by adhesive-plaster strips across the abdomen. Recovery was without incident and the patient sent home in a week.

The second, a girl, when four months old, was perfectly well until the evening of October 29, 1919. She suddenly and without any apparent cause began to cry. This continued all night, and the following day Dr. Israel Myers was called. During this day and the next no relief was afforded. Two stools had occurred so that there was not complete intestinal obstruction, and this made the diagnosis more difficult. No abdominal tumor could be felt even by digital examination of the rectum. Doctor Myers called in Dr. James H. McKee on Saturday and intussusception was diagnosed. Operation was begun about 8 P.M. on the same evening at St. Agnes Hospital. A right rectus incision opposite the umbilicus exposed distended small intestine. The large bowel was found above and to the left side of the abdomen and soon seen to be the site of an indurated mass which proved to be an intussusception. The proximal end of it was exposed with considerable difficulty near the midline at the level of the transverse colon. The entering portion of the small intestine (intussusceptum) was held firmly and closely to the posterior abdominal wall and was exposed with much traction on the surrounding viscera. The distal end of the intussusceptum was felt and seen to extend more than

EXCISION OF PORTION OF HUMERAL HEAD

halfway through the sigmoid loop and to move backward and forward within the intussusciens, showing that it was not adherent. After prolonged but gentle traction on the small intestine and pressure from below on the end of the intussusceptum it was gradually and completely reduced.

There were no adhesions and no lymph-masses indicating inflammation. It was observed in this case that as the final steps of the reduction were taking place the ileocecal junction appeared first, then the base of the appendix, followed by the whole appendix, and finally the end of the cæcum successively. This would seem to indicate that the last part to appear was the first to go in in the formation of the intussusception, *i.e.*, that the first part to invaginate was the end of the cæcum and not the ileocecal junction as commonly supposed. Healing was uneventful and the patient was taken home at the end of a week.

EXCISION OF PORTION OF HUMERAL HEAD FOR RECURRENT DISLOCATION OF THE SHOULDER

DR. T. TURNER THOMAS said that he had referred briefly to the case he was now reporting in a communication now awaiting publication and would like here to develop from later occurrences and findings at operation in this case a very definite cause for some failures following the capsule operation. Of forty-eight shoulders on which operation has been done for recurrent dislocation, about twenty were epileptics. There were two distinct failures in the non-epileptic group and three in the epileptic. The particular cause of the failure was not discovered, except possibly in two epileptics in which the convulsions were very violent. The case here reported was shown at the operation to have recurred after each of two capsule operations, because the wearing away of the two bones forming the shoulder-joint where they come into violent contact in each dislocation had gone so far that their ability to retain the normal joint relations had disappeared. In practically every operation performed by the writer he had found the evidence of this wearing effect always in the same parts, *i.e.*, the posterior portion of the cartilage-covered part of the humeral head and the anterior glenoid margin. It has never seemed possible to determine when it has gone too far to permit a cure by the capsule operation. In one case, operated on eleven years ago, the dislocations had been occurring for between twenty-five and thirty years before operation and have never occurred since, although he had as many as one dislocation a day for one week and three in one day, and at operation a considerable defect was found at the usual site on the humerus and some defect of the anterior glenoid margin. The following case proves that the wearing effect can progress so far that a capsule operation will not be sufficient to cure.

Male, forty years old, an epileptic in the insane department of the Philadelphia General Hospital. First capsule operation done June 19,

1919, the second October 11, 1919. About December 1, 1920, he sustained the second dislocation following the second operation. After the first the shoulder had been immobilized about three months in an effort to add to the cicatricial tissue at the site of the original capsule tear and thus prevent further dislocations. A few days after this last dislocation an interne attempted reduction of the dislocation, and although he was confident he accomplished reduction, could not keep the head in the socket. A few days later still the writer had a similar experience. On December 13, 1920, with much difficulty and care the capsule was exposed through a posterior axillary incision. On opening the joint nothing more than the wearing away of the two bones at the usual sites was discovered, but while the humeral head could be placed in the glenoid cavity it could not be kept there because the glenoid would not retain it, but permitted it to slip over the anterior margin into the subcoracoid position. As the capsule operation had been a complete failure he did a partial excision of the humeral head as described and illustrated in the *ANNALS OF SURGERY*, April 2, 1917, p. 493. Both wounds were closed completely except for a small rubber drainage tube opening in the axillary wound. The tube was removed on the following day and the healing was uneventful.

With regard to the underlying pathology of shoulder dislocations, nearly twenty years ago Dr. G. G. Davis began to produce these dislocations on the cadaver, and he produced by hyperabduction apparently exactly the kind of dislocation that one usually gets in life. They could produce as many as they pleased and study them as much as they wanted. One thing he observed early was what Doctor Allis expressed forcibly, that it was difficult to prevent spontaneous reduction. After the head goes out of the socket in hyperabduction and the arm drops to the side there is a great strain on the head in the direction of the socket. But in many instances the anterior glenoid margin by its pressure against the posterior cartilaginous portion of the head offers an insuperable obstruction. In the cadaver dislocation, as Allis pointed out, the head slips over this obstruction easily and probably often does in life. When the locking occurs the pressure is so great that there soon develops a more or less deep groove in the humerus and a flattening of the anterior glenoid margin. In the excision he removed only the part of the head that offered resistance to the anterior glenoid margin and this constituted only a small portion and the only part that projects out of the socket in the dislocation. It is difficult to conceive of a dislocation occurring afterward. It may be possible, but he felt certain that if any part of the head leaves the socket in hyperabduction it can not stay out when the arm comes down to the side. One patient had three capsule operations done on his right shoulder preceding the excision, but all were failures. But there have been no dislocations complained of since the excision in the right shoulder about four years ago, and in the left one and a half years ago.

STRANGULATION OF AN INGUINAL HERNIA

STRANGULATION OF AN INGUINAL HERNIA FOLLOWING A HALSTED OPERATION

DR. T. TURNER THOMAS presented a young man who, soon after rising from bed, on December 11, 1920, and while he was wearing a truss, was seized with severe pain in the region of his left inguinal hernia and throughout his abdomen, such as he had never experienced before. He was admitted to the Northeastern Hospital about 8 A.M. the same day and operated on about 9 A.M. Examination just preceding operation revealed a small, firm tumor at the site of the external inguinal ring about the size of a walnut which the interne had tried to reduce without success. He had no bowel movement for twenty-four hours preceding admission. The hernial tumor was very tender to pressure which caused a nauseating pain in the abdomen. There was marked abdominal rigidity.

About twenty-five years ago he says he was operated on for a left inguinal hernia. March 22, 1919, he was operated on for a double inguinal hernia, but in the following June had a recurrence on the left side and a third operation was done for it on August 6, 1919. When fully etherized for the fourth operation on December 11, 1920, light pressure reduced the hernia fully. Upon exposure by incision the hernial sac was found protruding from the external ring only, and there was no bulging in any other part of the canal. The vas deferens was seen coursing upward and outward lying on the external oblique aponeurosis, and it was traced to the site of the internal ring where the finger could be pushed easily through a considerable opening in the external oblique. There was no protrusion here at the time of the operation, and none was found on examination just preceding operation, but the patient says that the only hernia he knew anything about preceding this acute attack was at the internal ring where he said the pressure of the truss pad was exerted. A few veins were found passing upward with the vas and disappearing through the internal ring.

The external oblique was divided as in a Bassini operation, the hernial sac was opened and the index finger passed through the neck of it into the abdominal cavity. The patient at this time coming partly out of the ether and straining the muscle gripped the finger very tightly, indicating that the strangulation was probably due to this muscle contraction. The internal oblique and transversalis muscles were found separated from the shelving edge of Poupart's ligament and this separation continued for an inch or more to the outer side of the internal ring. The operation was completed as in a Bassini, the remains of the cord being left between the internal oblique below and the external above.

DR. HUBLEY R. OWEN said that they had quite a number of cases of hernia in the Police and Fire Departments. Many of these cases have been operated upon with excellent results. There had not been many recurrences. It was his opinion that of these recurrences the majority are due to lack of after-care of the patient, and not to the technic em-

ployed at the time of the operation. During his own absence, without meaning to say anything derogatory to anyone who may have substituted for him, the number of cases of recurrent hernia increased three times the number they had usually had. When he investigated he found men on active duty in the Police and Fire Departments one month after their discharge from the hospital. The rule had been to order a man on light duty one month after his discharge from the hospital, and no heavy duty for three months after the operation. He believed this to be a very important point. Of two cases of recurrent hernia operated on recently, he found that they had returned to laborious work in less than a month after the primary operation. It is the usual thing in a hospital that after the stitches have been removed the resident discharges the case in about two or three weeks, and no advice is given to the patient, and he returns to laborious work too early.

He had had two unusual cases recently. Both were bilateral inguinal herniæ. They returned to him six weeks after operation and each had a femoral hernia on the side on which he had transplanted the rectus muscle.

SLIDING HERNIA OF THE URETER

DR. GEORGE G. ROSS read a paper with the above title, for which see page 613.

AMNIOTIC HERNIA

DR. E. J. KLOPP reported the case of a female child delivered at full term July 22, 1920, by Dr. George A. Ulrich. It was the mother's first pregnancy. The head and shoulders were born spontaneously, the body stuck and required extraction. The membrane over a large abdominal protrusion was torn, and there was bleeding from the vessels of the cord. A clamp was applied to control the bleeding, the cord was ligated and cut. A large pad of cotton was placed over the abdomen and the child was taken to the Jefferson Maternity Hospital, where it was operated upon fifty minutes after birth.

Occupying the greater part of the abdominal wall was a hernial protrusion, the covering was almost transparent and composed of amnion and peritoneum. A considerable portion of the small and large intestines had escaped through a two and one-half inch opening in the sac which occurred during birth. The liver was rotated, adherent and part of it contained in the protrusion.

The intestines were returned to the abdominal cavity, which was poorly developed. No attempt was made to free the liver. After ligation of the vessels the excess amnion was excised and the opening closed by mattress sutures of catgut, making considerable pressure on the abdominal contents. No attempt was made to bring the muscles together. The skin was incised around the margin of the hernia and extensively undermined in all directions, then sutured vertically over the amnion.



FIG. 1.—Amniotic hernia.

PATENT URACHUS WITH SARCOMA DEVELOPING IN THE WALL

Seven days later some of the skin sutures pulled out, there was a little infection and finally retraction of part of the skin. The inner layer remained intact.

At first the child was fed modified milk with a dropper, later it took the bottle. Weight at birth, four pounds twelve ounces; weight September 6, 1920, five pounds three ounces; weight December 1, 1920, eight pounds three ounces. Accurate measurements of the hernia were not obtained before the operation. The child digested well, it cried as healthy children cry and was otherwise normal. The condition five weeks after birth is shown in the photograph (Fig. 1).

About December 1, 1920, it contracted pneumonia, and apparently recovered. Several days later there were symptoms of otitis media. The pediatricist in attendance incised both tympanic membranes. There was a copious discharge of pus from both ears. Notwithstanding free drainage, the temperature continued to rise and death occurred December 17, 1920.

The reporter's opinion was that the opportune time to operate upon cases of amniotic hernia is within a few hours after birth, before the stomach and intestines become somewhat distended with fluid, making closure more difficult, and before the amnion has begun to dry. It is questionable whether one should attempt, at this time, to bring the muscles together when there is a large defect in the abdominal wall.

PATENT URACHUS WITH SARCOMA DEVELOPING IN THE WALL

DOCTOR KLOPP reported the history of a man, aged fifty years, who was admitted to Doctor Stewart's service, Jefferson Hospital, January 26, 1920, whose general health was good until two weeks ago, when he complained of abdominal pain, particularly about the umbilical region. When he applied at the dispensary for treatment, a small amount of thin, yellowish fluid was discharging from the umbilical region. The umbilicus and skin near by were inflamed. There were no urinary symptoms. Physical conditions otherwise were normal.

January 28, 1920, under general anæsthesia, at the suggestion of Doctor Stewart, a curved incision was made above the umbilicus. A small cavity was entered beneath the skin which contained but a few drops of yellowish fluid. A gauze drain was inserted. He was discharged from the hospital February 2, 1920. On March 2, 1920, he was readmitted to the hospital, in the service of Doctor Gibbon, to whom I am indebted for the privilege of operating upon and reporting the case. There was an intermittent sero-purulent discharge from the umbilicus.

Operation (March 3, 1920).—Under general anæsthesia. A ureteral catheter was inserted for five inches. An elliptical incision was made around the umbilicus and then continued down toward the pubes. The umbilicus and tissue surrounding the catheter were excised. The catheter extended to within two inches of the bladder, from there on a cord-like

mass connected with the bladder. The omentum was adherent to the tract about an inch below the umbilicus. The abdomen was closed without drainage. The specimen was incised to demonstrate to students and a small section became detached and probably did not accompany the larger part to the laboratory.

Pathological Report by Dr. W. M. L. Coplin, March 10, 1920.

"Specimen consists of an irregular mass weighing 19 grams. One surface is covered by skin measuring 5 centimetres by 1.3 centimetres. Near the centre of the skin is the umbilicus, which is funnel-shaped and very deep, admitting the little finger to the first joint. As far as one can see, the funnel is lined by skin. A probe 2 millimetres in diameter inserted into this depression enters a canal which terminates 9 centimetres from the skin surface. At one area 4.5 centimetres from the skin, the canal has been opened, disclosing a rich red lining membrane. Fixation in 10 per cent. formalin; usual laboratory stains.

Histology.—The centre of the section is occupied by a canal 0.3 centimetre in diameter, small arc of which is lined by squamous epithelium, and probably represents the original tract. The remainder of the wall of the sinus is inflammatory tissue. Outside of this is considerable loose areolar tissue and some more compact and fibrous structure. Near one margin and extending into the tissue is a mass of mononuclear cells also containing a few giant-cells; it is believed that this area is sarcomatous. The structure believed to be new growth extends close, if not actually, to the periphery of the specimen, and it seems unlikely that all the diseased tissue has been removed.

This description is based on a transverse section of the specimen about one centimetre internal to the external opening.

Diagnosis.—Umbilical fistula, obviously the remains of a fetal structure, possibly urachus or omphalomesenteric canal. In the thickened inflamed wall sarcoma is believed to be developing."

He received four X-ray treatments at three week intervals after the operation.

The Wassermann was plus 2 prior to the operation and plus 1 December 31, 1920. There has been no history of lues nor has he ever had treatment for it. The wound is healed and symptomatically he is well.

ACUTE INFLAMMATION OF MECKEL'S DIVERTICULUM

DOCTOR KLOPP presented a man, aged forty-seven years, who was referred by Dr. C. D. Smith to the Jefferson Hospital, November 19, 1920. He had complained of indigestion and gaseous eructations for many years. Frequently he was compelled to fast for several days. There often was nausea but he seldom vomited. Two years ago he was supposed to have had an attack of appendicitis. He was confined to bed for three days at that time.

On November 17, 1920, he had nausea and vomiting which was followed by generalized abdominal pain. He took cathartics, but his bowels did not move. The pain became more intense, and two days after the onset he called Doctor Smith.

On admission his temperature was 100.6°; pulse, 100; respiration 20. His facial expression indicated pain. The abdomen was distended, there was tenderness throughout, most marked, however, over the right lower

PYONEPHROSIS WITH LATE SECONDARY HEMORRHAGE

quadrant where a mass could be detected. On November 19, 1920, under general anæsthesia the abdomen was opened over McBurney's point. Several ounces of turbid fluid were wiped away. The mass was walled off by a gauze pack. A structure two inches long and three-fourths inch in diameter, having a mesentery and springing from the ileum approximately eighteen inches from the cæcum, dark red in color and in several places gangrenous, was removed by the technic one removes the appendix; in fact, this structure resembled an appendix very closely. From its location and appearance we called it an acutely inflamed Meckel's diverticulum. To the right of a hard, omental mass, and attached to it, was the appendix. It also showed evidence of inflammation and therefore was removed. Two gauze drains were inserted with the usual closure in such cases. The man made an uninterrupted recovery.

Cases of inflammation of Meckel's diverticulum are not common. It is said that there may be recurrent attacks, or that there may be perforation and peritonitis. One could not say whether the attack of so-called appendicitis two years ago actually was appendicitis. If the appendix had been encountered first in this operation the diverticulum might have been overlooked.

PYONEPHROSIS WITH LATE SECONDARY HEMORRHAGE

DR. ARTHUR E. BILLINGS reported the history of a colored man, aged twenty-five years, who was admitted to the Bryn Mawr Hospital October 20, 1920, complaining of pain and tenderness in the region of the left kidney, with fever and sweats. He said he had had bladder trouble since early childhood. In 1918 he had a large stone removed from his bladder at Camp Sherman, Ohio. Later in 1918 he had a fourth attack of pneumonia in Camp Humphreys. He stated that all of the pneumonic attacks had been on his left side. Had not had any other serious illness and denied all venereal infection.

About August 1, 1920, while chauffeuring in France, he began to have pains in region of left kidney, with increased frequency of urination, but at this time was not disturbed at night by either pain or frequency. He was given some medicine by a French physician which gave him much relief. Several weeks later his symptoms became aggravated and he observed "blood, pus and gravel" in his urine. This, he said, increased until his urine was about half sediment. About this time he returned home and consulted Doctor Ferries, who referred him to Doctor Pancoast for X-ray; the skiagraph showing a rather long, conical stone in the left renal pelvis, apparently engaged in the ureter. He was then referred to me by Doctor Ferries on October 20, 1920, with a temperature ranging from 100° to 103°; pulse, 90 to 100, with sweats and a large, palpable, tender mass in left kidney region. Leucocyte count was 19,200, and his urine was loaded with pus, but was negative otherwise, except for a heavy trace of albumin. Kidney function (indigo carmine) showed a total

elimination of about 45 per cent. in two hours, all of which was from the right kidney. Physical examination, aside from that already noted, was negative. Blood, Wassermann was negative.

On October 22, 1920, under N_2O and O-ether anæsthesia the left kidney was exposed through the usual curved incision in the back. A nephrectomy was done with some difficulty, as the kidney was very adherent, particularly to the descending colon. The kidney was very much enlarged and was merely a shell with a large abscess cavity within, as the renal tissue seemed to have been almost entirely destroyed. Urine output for first twenty-four hours after operation was 875 c.c., and by the fifth day it had increased to 1975 c.c. His convalescence in the hospital was satisfactory and his wound cleaned up rapidly under the influence of Dakin's solution. Culture from pus showed bacillus coli communis and pathological diagnosis was tuberculosis of kidney with pyonephrosis. He left the hospital (November 18, 1920) twenty-six days after operation, with a small sinus from which there was a very slight sero-purulent discharge. Cicatrization seemed to have been satisfactory, and he gained about twelve pounds in the following two weeks. On the 4th of December he had pain in region of wound and back, with bloody discharge from sinus. On December 6th he had a great deal of pain in back and left upper abdomen, with increased bloody drainage from sinus. (Admitted to Pennsylvania Hospital.) Temperature, 101° ; pulse, 120. Tenderness in left upper abdomen with indefinite mass formation. Wound opened; considerable blood-clot evacuated. No active bleeding point found, except from excessive granulation which gauze packing controlled. Temperature ranged from 101° to 103° . Leucocyte count, 27,200. Blood culture, negative. Blood, Wassermann weakly positive. On December 16th had rather profuse hemorrhage, at least twenty-five ounces. Wound tightly packed with gauze. Patient profoundly septic. A donor was obtained for transfusion, but their bloods were incompatible, and another was not secured. An intravenous infusion of salt solution caused temporary improvement, but patient died on December 17, 1920. Permission for autopsy was not granted, but exploration through wound revealed that hemorrhage had probably occurred from ulceration and sloughing of the ligated renal vessels, as they were necrotic with a large quantity of recent blood-clot about them.

Attention is called to this case because of the elapse of fifty-five days between operation and occurrence of secondary hemorrhage, and the fact that he was looked upon as a certain operative recovery when discharged from Bryn Mawr Hospital.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting held January 12, 1921

The President, DR. WILLIAM A. DOWNES, in the Chair

MARGINAL ULCER OF THE JEJUNUM FOLLOWING GASTRO-ENTEROSTOMY

DR. EUGENE H. POOL presented a man who had been operated upon elsewhere in May, 1919, for duodenal ulcer, a posterior gastroenterostomy having been performed, with exclusion of the pylorus. The patient returned six months later with gastric hemorrhages, and received medical treatment. He came to the New York Hospital in December, 1920, suffering from symptoms of gastric ulcer. The X-ray plates (Fig. 1) showed a large ulcer in the region of the gastroenterostomy and no bismuth passing through the pylorus.

Operation was performed five weeks ago. Many adhesions were found around the pylorus and it was impossible to ascertain how it had been occluded. There was a short loop posterior gastroenterostomy. The tissues around it were markedly indurated and infiltrated. The stomach was opened through its anterior wall and the stoma and ulcer inspected and palpated. There was a penetrating ulcer about 2 cm. in diameter in the posterior wall of the jejunum close to the stoma. It had an elevated, hard border. The stomach and jejunum were separated and the indurated tissue was excised from around the orifice; in each organ the opening in the posterior wall was then closed by sutures from within the stomach (transgastric), reinforced by an outer layer from below. The jejunum could not be closed transversely on account of the extensive adhesions and a longitudinal suture had to be made, but it was found that this diminished the lumen to a dangerous degree and left an insecure closure, so the jejunum was doubled on itself at the middle of the line of suture (like a V), bringing the two halves of the line of suture into contact and placing Lembert sutures between the adjacent segments anteriorly and posteriorly. Above this approximation, to reestablish the patency of the jejunum, a suture anastomosis was made. A posterior gastroenterostomy did not seem appropriate nor feasible and the opening in the anterior wall of the stomach was used for an anterior gastrojejunostomy about fourteen inches down from jejunum. An eight-ounce bismuth meal observed at intervals by fluoroscopy now passes quite slowly, taking about four hours; the patient complains of no discomfort.

EXOSTOSIS OF SCAPULA

DR. SETH M. MILLIKEN presented a case of exostosis of posterior border ventral surface of the scapula, projecting against a rib. He stated that the patient, a girl aged twenty years, had for the last six months noticed "a scraping in her right shoulder," which was not painful but made so much noise that it disturbed her.

Examination showed a well-nourished young woman. Any motion of her right shoulder caused a knocking noise audible across the room. The right shoulder was held slightly lower than the left. Careful general examination showed no abnormality except in the right scapula, as follows:

The posterior border of the right scapula was slightly winged out. Pressure caused less yielding than on other side. Movements of the scapula were accompanied by a knocking sound and a palpable bumping. This bumping should be pathognomonic, as it was due to the exostosis jumping over the ribs in movements of the scapula. Very clear X-rays made by Dr. L. G. Cole proved the diagnosis. Doctor Cole reported as follows: "Plates taken in two planes show definite evidence of a rather large exostosis on the ventral surface of the scapula close to its posterior border, about the junction of lower and middle thirds. This projects anteriorly and when the arm is moved it slips over the ribs, giving the characteristic sounds and vibration, which is so distinctly felt."

CHRONIC EMPYEMA

DR. WILLY MEYER presented a girl in the later twenties, whom he had presented before this society two years ago when her wound was in the course of healing. She had had an empyema when four years of age when she had a rib resected; the empyema cavity had never healed. Doctor Meyer said she came under the care of a number of surgeons later on, and one could see the results of their work by the number of scars surrounding the scapula. Due to their work the greater portion of the empyema cavity was closed, but a large cavity persisted which, when she came under his care in 1915 with a fistula, was shown by bismuth injection and radiography to extend parallel with the spine from the shoulder to the lower border of the ribs posteriorly. It was $1\frac{1}{2}$ inches wide. According to two similar cases which he had had before, it had been his experience that the only way to attack this type of empyema was to remove the entire roof that covered the cavity. Making an incision down through the ribs and trying to free the lung by Delorme's decortication was not feasible. He planned to do the work in stages and under regional with local anæsthesia. When the cavity was exposed he was amazed to see how far it extended downward; it looked as though it reached into the small pelvis. Before he had completed the operation the patient went into shock. The large wound was tamponed and the



FIG. 1.—Marginal ulcer of the jejunum following gastroenterostomy.

skin flaps turned in. There remained two sinuses, one running up and one running down, each into the respective angle of the original cavity. He first attacked the lower one and in a third sitting the upper one. There were a number of bronchial fistulæ which persisted, but at last closed after repeated cauterization. To-day, after almost five years of continuous treatment, he could show the patient completely cured. The healing wound resembled a posterior mediastinotomy; the heart could be seen pulsating. There was full function of the arm.

Doctor Meyer stated that three cases of this type of chronic suppuration had taught him the necessity of going ahead cautiously. These patients frequently went into shock, even when every precaution had been taken. He believed that where possible local anæsthesia should be used.

THE MURPHY BUTTON IN INTESTINAL WORK

DR. WILLY MEYER presented a woman who was operated on by him in 1917 for a strangulated gangrenous umbilical hernia, with resection of the gut and an end-to-end anastomosis. She was at that time fifty-three years of age and had had the umbilical hernia for eighteen years. She was brought to the hospital and operated upon at midnight. The necrosis had spread to either side of the incarcerated sector; it was necessary to resect 55 inches of the ileum. The walls of the afferent part of the intestine were quite distended and œdematous, those of the efferent part contracted and anæmic. Under these conditions Murphy's button seemed to offer the best means of bringing the cut ends of the intestine together quickly. Doctor Meyer emphasized his belief that under these conditions the Murphy button had its clear indication. The radical operation for umbilical hernia was added. The patient left the hospital cured.

In March, 1920, Doctor Meyer was again called to see this patient, and found her with all the signs of a constriction of the pylorus which had developed rather quickly. A tumor could be palpated. Again a transverse incision was made nearer the lower border of the ribs, but the stomach could not be conveniently exposed. He then added a median incision up to the xiphoid process, but not dividing the peritoneum. Now it was feasible to reach the lesser curvature and the strictured pylorus. Metastatic carcinomatous nodules covered the entire stomach anteriorly as well as posteriorly, also the transverse mesocolon. It did not look as though operation would avail anything, but a posterior gastroenterostomy with the button could still be done. This brought out the second point he wished to make, that when one saw these patients whose condition seemed totally hopeless, one should nevertheless endeavor to help them by making an anastomosis. The Murphy button offered the only means of doing this. In this case he found a small area in the posterior wall where he could implant the button. The patient certainly was in a very poor condition on March 20, 1920, the day he operated. She now weighed fifteen pounds more than at that time. The case showed what

could still be done with the help of the Murphy button in these otherwise totally intractable cases.

DR. FREDERICK T. VAN BEUREN, JR., quoted from the records at the Roosevelt Hospital, stating that in the last ten years there were twenty-three cases of resection of the ileum. Of those cases fifteen had died and eight recovered; that was a mortality of 66 per cent., which was pretty high. It was no higher, however, than the statistics of the Massachusetts General Hospital in similar cases. He found four cases among the twenty-three in which the Murphy button had been used. Of these two died and two recovered, a mortality of 50 per cent. Doctor Van Beuren said that he personally had done only five such operations with the Murphy button. Of these three recovered and two died, a mortality of 40 per cent. So he still thought with Doctor Meyer that, though many other men had discontinued its use, the Murphy button still had a useful place in certain selected cases.

DR. CHARLES N. DOWD said that he had not used the Murphy button for several years excepting in one locality. That locality was the hepatic flexure of the colon, in making a side-to-end anastomosis with the terminal ileum after resection of the ascending colon. It here had the advantage of rapidity, simplicity and cleanliness, and the disadvantages of the button were reduced to the minimum since it lay in the large intestine after its separation and easily passed to the anus. It was a valuable resource in debilitated patients. One part of the button was fastened into the end of the ileum with a purse-string and the other was dropped into the open end of the colon and pushed through a small cut in its side. The button was then locked. The end of the hepatic flexure was closed, and the suture was so secured in the abdominal wound that access to the suture line could be obtained if desirable. Charles H. Mayo had described the procedure at the meeting of the A. M. A. in 1916.

DR. HOWARD LILIENTHAL said there was one time when the Murphy button was extremely useful, and that was when one wished to operate quickly, as when a patient had gangrene of the gut and was in desperate straits. He incised the gut through the gangrenous portion, slipped the two halves of the button into the two legs of the involved loop far into the healthy portion, and, after nicking the intestinal wall so the cylinders of the button could be pushed through, he clamped the button home without sutures. He then ligated both legs of the gut with a single stout crushing ligature and cut away the part bearing the gangrene. The two stumps were carbolized and did not need to be inverted. The ends of the knot could be left long, protruding from the external wound, so that when the stumps were loose the slough could be drawn out of the wound.

DOCTOR MEYER believed that if surgeons followed the technic in the use of the Murphy button as Doctor Murphy himself described it, there would be fewer deaths from accidents following its use. One of the reasons for his having brought the patients here to-night was to show that the

SADDLE-BACK ULCER OF STOMACH

Murphy button had its indication. In patients with shock after strangulated hernia it certainly did save time. In one very weak patient with cancer of the stomach whom he had once shown here he had used two Murphy buttons. In this patient he found the posterior wall of the stomach completely adherent to the transverse mesocolon. Resection of the stomach and also of the transverse colon became imperative. End-to-end union of both organs was done with the button and the patient made a good recovery.

SADDLE-BACK ULCER OF CENTRAL THIRD OF STOMACH

DR. ALLEN O. WHIPPLE presented a woman, aged twenty-six years, who three weeks before admission was seized with sudden, severe pain referred to left lower quadrant of her abdomen. This persisted, growing worse for three days before admission. During the three weeks she had had persistent nausea and had vomited after each meal. No pain in the epigastrium after meals, no tenderness, no blood in the vomitus, no tarry stools, bowels regular, no hæmaturia, no history of digestive disturbance prior to this outbreak since removal of appendix ten years before. There were tenderness and increased resistance in the left lower quadrant. Three days later an examination of the vomitus and stool gave a positive guaiac test. She vomited 600 c.c. of coffee-ground material. Attempts to use fluoroscope and röntgenograms were useless, owing to her inability to retain bismuth. The coffee-ground material was the only evidence made out of a gastric lesion. An exploratory section was made because of her severe pain and dehydration before operation. She was given a hypodermoclysis.

Operation (August 23, 1919).—Through a suprapubic incision nothing was found to explain her left lower quadrant symptoms. Uterus and adnexa were not inflamed; sigmoid was normal.

Situated in the lesser curvature of the stomach was an indurated mass lying saddle-like over the lesser curvature. No enlarged, hard nodes were felt in the gastrohepatic omentum, or near the cardiac. There were no adhesions binding the stomach to liver or pancreas. A sleeve resection was decided upon inasmuch as the pylorus was not involved and the saddle ulcer could be removed with the central third of the stomach. Payr clamps were used, central third excised, cut ends cauterized, posterior serosal sutures of No. 0 chromic applied and Payr clamps removed. The crushed ribbons were trimmed and the through-and-through continuous sutures of No. 0 chromic were placed, using a lock stitch for the posterior line and inverting Connell suture for the anterior line. Serosal suture was then continued to point of beginning.

Post-operative Course.—She complained of nausea at intervals but had no vomiting at any time. She left the hospital on the seventeenth day, in very fair condition, on a selected post-operative gastro-

enterostomy diet and was given detailed advice as to her diet and bowel regime. Wound healed by primary union.

Follow-up.—She has been seen five times. For seven months she continued to have morning nausea and regularly vomited her morning meal, but not other meals. Menses regular, no evidence of pregnancy. Nausea was somewhat relieved by cerium oxalate. Seven months after operation röntgenograms showed no retention. Stomach emptied rapidly and was entirely empty in six hours.

On her fifth visit, thirteen months after operation, she was symptom free. Nausea had entirely disappeared. No tenderness or mass was made out. Anatomic, symptomatic and economic result for thirteen-month interval was optimum or 444.

LATE RESULT AFTER RESECTION OF THE STOMACH FOR CARCINOMA

DR. WILLY MEYER presented two patients who had been operated upon for gastric carcinoma to demonstrate the possibilities of surgery in such cases. Unless a fair number of permanent cures were reported showing the final results, the medical men would not be so ready to turn over these cases for operation at the earliest possible moment. From the Mayo Clinic and from many clinics abroad a series of cases of carcinoma of the stomach had been reported which showed good late results.

A former patient came to his office last fall; he did not recognize her at first, but soon remembered having done a resection for carcinoma five years ago. He then thought he would like to follow up other cases similarly operated upon. In this way he succeeded in quickly tracing five such patients. The first patient he now presented was a man who came under his care in March, 1916, when fifty-six years of age. At that time he had a big palpable tumor of the stomach with all the signs of beginning pyloric carcinoma. With the transverse incision the tumor was exposed. It was impossible to do a posterior gastroenterostomy, so an anterior gastroenterostomy was done and the patient did well and made a good recovery. He had gained 18 or 20 pounds, was now sixty years of age, and was in perfect condition.

Speaking of the transverse incision, Doctor Meyer stated that he found that with this incision the layers of the abdominal wall did not come into as firm an apposition as they should and he was not using it as much as he did some years ago. From under the muscles one sometimes had secretion for some time; but the wound would never separate.

The second patient presented was forty-one years of age in 1815 when operated upon at the Post-Graduate Hospital, also through the transverse incision. A resection of the stomach was done for a tumor on the major curvature and a constricted pylorus. He did a posterior gastroenterostomy with the help of a Murphy button.

In looking up his patients he had found three men who had lived quite a number of years after operations for carcinoma of the stomach. One,

LATE RESULTS AFTER RESECTION FOR CARCINOMA

operated upon when sixty-one years of age, lived ten years, and then died of arteriosclerosis. There were two more cases of gastric carcinoma still alive in the city, one after a resection according to Billroth No. 2, and one after a Reichel-Polya-Balfour operation. Doctor Meyer said he felt absolutely sure that if other surgeons would follow up their patients they would find quite a number that were thought to be incurable alive and well after a number of years. After all it was probably a question of the virulency of the cancer, whatever it might be, which determined the patient's fate.

DR. JOHN F. ERDMANN presented three patients. The first was a man, aged forty-nine years, operated on in December, 1910. He had a large tumor and quite a collection of enlarged glands. His physician said he entertained very little hope of his recovery. At operation four-fifths of the stomach was resected for adenocarcinoma.

The second patient, a woman aged seventy years, was an emergency case. A diagnosis was made of probable ulcer of the lesser curvature. The X-ray plate showed a condition like carcinoma. The patient was operated upon in November, 1920. A sleeve resection was done of the middle third for a large ulcerating mass adherent to the pancreas. There was said by the pathologist to be no malignancy, but only an ulcer.

The third patient, Doctor Erdmann said, had a bearing on the subject of the evening. This man, aged twenty-six years, came under his care in January, 1920, with clinical symptoms of duodenal ulcer for which he was operated upon on February 10, 1920. It was found in resecting the ulcer from the anterior superior portion of the duodenum that there was a second ulcer on the posterior surface just opposite the first, a so-called kissing ulcer. This was also resected and, fearing a stenosis, a gastro-enterostomy was performed. In May the man returned, complaining of the same symptoms that he formerly had. He was treated with alkalies and dietetic measures. On November 18, 1920, he returned with all symptoms marked, and pain deflected to the left lower quadrant. Thinking the man had a recurring or marginal ulcer he was operated upon on December 17th. At operation examination of the former resection showed no original disease. The duodenum just outside the pyloric sphincter was found distended. The duodenum was fully normal in size, possibly a little larger. In the absence of any other pathological condition, he felt that there was probably a marginal ulcer and further search revealed a perforated ulcer the size of a twenty-five-cent piece at the mesenteric margin of the jejunum. The ulcer was excised. Normalcy of the gastrointestinal tract was established by closing the opening in the stomach and also that of the jejunum.

DR. JOHN DOUGLAS said he would like to place his cases of malignant disease of the stomach on record. He had done twenty-two resections, nineteen for carcinoma and three for sarcoma. One case of sarcoma was shown before the society one year ago. That patient still is well two

years after operation. One of the carcinoma patients was operated upon in March, 1912, and another in November, 1912, eight and nine years ago, and both were without signs of recurrence. Two other cases were operated upon a little over two years ago and were perfectly well. Two cases operated upon during the last seven or eight months were still well. A total of six cases of carcinoma and one of sarcoma, operated upon from five months to nine years ago, were still alive and well.

SLEEVE RESECTION OF MID-GASTRIC ULCER

DR. WILLIAM A. DOWNES showed a slide and a picture of a patient upon whom he did a sleeve resection for a mid-gastric ulcer in November, 1914. The slide showed the stomach before operation with retention, and a second slide showed the stomach after operation when it emptied in four hours. The woman came in a few days ago and he had had the picture taken to check up. It showed that the stomach was functioning perfectly. The patient suffered no discomfort of any sort. She had gained in weight, married, and did not know that she had ever had an operation. The sleeve operation showed remarkably good results. Sir Berkeley Moynihan, in a recent talk, apparently advised the removal of the pyloric portion of the stomach in these cases and suturing the jejunum to the open end. He made no mention of this operation at all. Doctor Downes stated that he had had six out of seven patients operated upon by this method living, one for more than seven years, and the results in all had been very satisfactory. He thought this operation had a very definite field for a selected type of cases.

DR. GEORGE WOOLSEY said that one reason the results were not as good as they otherwise would be was that this operation was often done for ulcers of a severe type, such as large, deep ulcers on the posterior wall adherent to the pancreas or ulcers with marked hour-glass contraction. The immediate results of sleeve resection were usually very good. Doctor Woolsey stated that he had had nine cases of sleeve resection and one had had to be reoperated upon on account of adhesions and constriction of the pyloric segment. So far as the follow-up results went, they had not been as satisfactory as those of some other operations, but that was to be expected because of the type of cases operated upon by this method.

MARGINAL, GASTROJEJUNAL OR PEPTIC ULCER SUBSEQUENT TO GASTROENTEROSTOMY

DR. JOHN F. ERDMANN read a paper with the above title, for which see page 434, *ANNALS OF SURGERY*, April, 1921.

DR. EUGENE POOL stated that he had operated upon three cases of marginal ulcer, the one he had first shown and two others. In addition, an unusual case of similar type, namely, an ulcer following a Finney pyloroplasty for duodenal ulcer of the anterior surface. At operation on the last case dense adhesions about the pylorus and duodenum made it

necessary to open the duodenum for exploration. He found an ulcer 1.5 cm. in length, not at the site of the original ulcer, but at the site of the upper end of the posterior suture line. The ulcer was markedly indurated. The original operator stated that non-absorbable suture had been used. Doctor Pool said that he wished to emphasize the following important point: On account of the possible disadvantages and even dangers which may result from a gastroenterostomy, it is always important to demonstrate that the procedure is positively indicated before such an anastomosis is made. If on inspection and palpation there is any uncertainty of the presence of an ulcer, the viscus should be opened to obtain positive information. In several cases in recent years he had avoided an unnecessary gastroenterostomy by this practice.

In another case the marginal ulcer was not only dependent upon non-absorbable suture, but the case showed an apparent individual predisposition to recurrence of marginal ulcer. In this case a posterior gastroenterostomy was made for ulcer of duodenum. Six months later the patient presented himself again with symptoms of ulcer. Doctor Pool operated again and found an ulcer, 1 cm. in diameter, close to the left extremity of the gastroenterostomy opening. On the floor of the ulcer was found the knot of the linen thread. He cut the thread and drew out the entire linen suture. This was five years ago, and since this experience he has never used non-absorbable sutures in a gastroenterostomy. There was no evidence of carcinoma. The ulcer was excised and a revision of the gastroenterostomy made. Six months later the patient again had symptoms of gastric ulcer. Again he was operated upon; this time elsewhere, and a marginal ulcer was again found. The surgeon made a resection of the jejunum and excised the ulcer. He did a new anastomosis with a Roux implantation of the jejunum. Some months later the patient returned to Doctor Pool, who found an extensive carcinoma at the site of the last gastroenterostomy. The patient died about four months later. In this patient there was a sequence of two marginal ulcers and a carcinoma.

DR. GEORGE WOOLSEY said that he had not had many jejunal ulcers in the past five years, during which he had not used non-absorbable suture material. During that time he knew of only one of his ninety-odd cases of gastroenterostomy reoperated for a marginal ulcer, and this was done by another surgeon. During that time he had only operated upon one patient for a marginal ulcer and the gastroenterostomy had been done at another hospital about two years previously. The symptoms had recurred about seven weeks before operation. In that case there was no visible thread, but there were clusters of foreign-body giant-cells, indicating the probability of such a suture, according to the pathologist. Doctor Woolsey said he believed non-absorbable sutures were the commonest single cause of marginal ulcer. In a paper by Doctor Eustermann, of the Mayo Clinic, the statement was made that a non-absorbable

suture was the cause of one-third of all marginal ulcers. But it was not the only cause. Doctor Coffee, of Portland, Ore., recently read a paper at Newark and showed some interesting pictures of three cases of jejunal ulcer in which the clamps were thought to be the cause of the ulcer. The ulcer was in a part of the jejunum where the clamp might have done the injury, not close to the anastomosis, but some distance from it. Doctor Woolsey had not seen this occur after the use of clamps. The use of many forceps, as suggested by Doctor Erdmann, might also subject the tissues to trauma and favor the formation of ulcer. If one used the Roosevelt clamps, however, and did not require many, if any, forceps on the edge of the incision, Doctor Woolsey stated that he had had no reason for abandoning the use of clamps in doing gastroenterostomy. Hæmatoma might be a cause of marginal ulcer or some other slip in the technic of the operation. The X-ray of the patient upon whom he had operated for marginal ulcer showed the ulcer, not so prettily as in Doctor Pool's case, but it made a very definite and positive diagnosis. Doctor Eustermann said that in 65 per cent. of the cases he reported the X-ray confirmed the diagnosis.

Doctor Woolsey asked Doctor Erdmann to explain more fully about the suture he proposed. Was it an exact suture of the mucosa, leaving out the through-and-through suture? Personally, he thought the ordinary method of suturing brought the mucosa perfectly well together. He had had occasion to open the stomach on account of hemorrhage in one instance, nine days after operation, and he found the edges as perfectly apposed as one could possibly make them by any method of exact suture. The hemorrhage was due to the ulcer. In another case upon which he had operated over seven years ago, using non-absorbable suture, and which he had reported previously, the symptoms recurred after twenty-one months. At operation no ulcer was found, but three inches of the non-absorbable suture was found hanging from the stoma. The removal of the suture cured the symptoms, which had resisted all forms of medical treatment.

DR. J. P. HOGUET recited the history of a patient operated upon by him in 1916 whom he showed a few months ago. At that time the patient had had two recurrences of marginal ulcer, one following a modified Polya operation and one after an ordinary excision. After the attack in 1916 an X-ray was taken which confirmed the diagnosis. Another attack occurred in 1917 in which no X-ray was taken but the symptoms were perfectly characteristic. The ulcer resolved under dietetic treatment. A month ago the patient returned with the third attack and a marginal ulcer was shown by the X-ray. This attack subsided after two or three weeks of alkaline and dietetic treatment. It was demonstrated after the attack that there was a chronic stasis at the splenic flexure of something like seventy-two hours. At the present time, Doctor Hogue said he was tempted to do an exploratory operation to find the cause of the stasis.

PEPTIC ULCER SUBSEQUENT TO GASTROENTEROSTOMY

He thought this case opened up a train of thought as to whether chronic stasis was not an etiological element in marginal ulcer.

DR. HOWARD LILIENTHAL stated that he had given up the use of non-absorbable suture material after he had had a case like Doctor Woolsey's in which the suture caused the symptoms of ulcer and after removal of the suture the patient got well. Since that time he had not used non-absorbable suture. What had been said about the clamps was especially interesting to him. He had never used clamps in any gastroenterostomy work. The clamp was not justifiable unless used as a crushing machine previous to excision. Where one wanted to retain the parts they should be handled as gently as possible. If a clamp were used it must be with great skill. One must judge of the strength of the clamp and also of the resistance of the individual patient's tissues. Doctor Lilienthal had used various methods, among them the coffee "holding suture." For seven or eight years he had used the rubber-dam method. In applying this method he took a large piece of rubber dam and made a punch hole in it about large enough for a lead pencil. He then placed marking sutures at each end of the proposed stoma. The assistant then pushed the marking sutures through the hole in the rubber dam, which was stretched to a suitable size by the operator, and when the viscera had been drawn through the rubber was permitted to contract so that the operative field was absolutely isolated, and by a material that would do no harm to the area to be operated upon. One could then proceed to make the stoma. The rubber dam did not cause complete hæmostasis, so that one could see just where each suture should go, and when the rubber dam was removed one would have the parts in relation just as they were going to remain. If one used a clamp, after the removal of the clamp the relation of the parts was changed completely.

Doctor Lilienthal said that while he had not had a large number of gastric and duodenal ulcers, he had had a considerable number and he had not had a recurrent ulcer that he knew of with the use of this method and absorbable sutures; and usually when his patients had any fault to find they came back. He had had a patient with a peptic ulcer operated upon sixteen years ago who came back after sixteen years without symptoms. The X-ray did not always show a penetrating ulcer; in order that such an ulcer could be shown by the X-ray it must be on the "sky line," so to speak.

DR. WILLY MEYER said the reason one did not see marginal ulcers oftener was evidently due to the presence of bile running through the anastomosis from the duodenum into the stomach. Ulcers were not found below the point where the bile entered the duodenum. When the acid gastric secretion ran through the pylorus and sufficient bile was not present to neutralize it, the gastric juices produced a deleterious effect. This certainly often was the cause of a duodenal ulcer.

Doctor Meyer always made use of the Roosevelt clamp, but he never

did press hard, just enough to hold the two portions in the proper apposition. Inasmuch as the anastomosis was inside of the place at which the clamps were applied, he did not see why they should be responsible for the formation of a marginal ulcer. He further thought the inner suture should always invert the tissues. He used but two rows of continuous layer suture.

Amongst the many cases of gastroenterostomy which he had had there was but one case of marginal ulcer. In this instance the X-ray specialist suggested the diagnosis of carcinoma at the anastomosis. But it did not appear to be cancer so far as the patient's general condition was concerned. The Einhorn duodenal tube for feeding was used and the patient improved very much. She had been operated upon at the Post-Graduate Hospital one and one-half years before and then came back with the symptoms of marginal ulcer. By means of the tube the parts were placed at perfect rest. The patient recovered without further operation. In cases in which it was difficult to get the consent to additional surgery, or the patient seemed to be a great risk, it was advisable to try intestinal feeding with the duodenal tube passing through the gastrojejunal anastomosis.

DR. JOHN DOUGLAS recalled that he had presented a case of jejunal ulcer before the society about a year ago, and while the subjective symptoms were somewhat similar to those mentioned by Doctor Erdmann, it differed from Doctor Erdmann's cases in the location of the ulcer not being in the stomach or on the margin of the jejunostomy and the fact that no stippling was evident. In the case referred to, the jejunal ulcer developed about a year after the gastroenterostomy. The patient had two hemorrhages after the gastroenterostomy and this, with severe pain and a negative X-ray finding, had aided in making the diagnosis. At the time of the operation there was no stippling or induration found. Doctor Douglas said he separated the jejunostomy with the idea of reestablishing the old opening at the pylorus and had found proximally from the opening a small jejunal ulcer $\frac{1}{2}$ cm. in diameter in which there was a non-absorbable suture thread. A recent letter from this patient stated that he was free of symptoms.

DR. WILLIAM A. DOWNES said that one point Doctor Pool made was worth while emphasizing, namely, that it was better to explore the stomach or duodenum if there was any doubt as to the presence of an ulcer. He had followed this plan and never had had occasion to regret it. If one had made a mistake and no ulcer was found, he could content himself by taking out the appendix and save an unnecessary gastroenterostomy.

Doctor Downes stated that he had not used the clamps in doing a gastroenterostomy for several years. He had had two cases in which hemorrhage occurred while using clamps, in one of which he reopened the stomach and examined the stoma. The continuous suture had broken. This case recovered but the other proved fatal. Without the use of

RESULTS OF REMOVAL OF SEMILUNAR BONE

clamps one could draw the two portions of the stomach and jejunum together better than with the clamps, and certainly hemorrhage could be controlled better. In his experience Doctor Downes had never seen a case of infection result from not using the clamps.

DOCTOR ERDMANN said that in reference to Doctor Pool's remarks as to the exploratory gastrostomy operation for duodenal ulcer, he had done that a number of times with the same results that Doctor Pool had recounted.

In reply to Doctor Woolsey as to high proportion of marginal ulcers following the use of silk and Pagenstecher sutures, Doctor Erdmann said that though all surgeons were now using absorbable sutures, still one saw recurrent ulcers. While he did not wish to minimize the use of non-absorbable suture as a cause of recurrent ulcer, he felt sure that the cause was not yet recognized. He could not say whether marginal ulcer was due to the use of clamps or not, but he very firmly believed there was some other etiological factor which had not been found. Whether it was an idiosyncrasy or a chemical change or simply a habit, which was equivalent to an idiosyncrasy, he could not say.

Doctor Erdmann stated that he had had in all four marginal ulcers in cases in which he had found non-absorbable sutures. In the application of the suture method he had spoken of he simply took up the mucosa of the outer half of the opening in such a way that the two edges were directly apposed. He took up the submucosa and muscular with the peritoneal layers with a Cushing right-angle stitch, making the third row of Lembert sutures. Out of over three hundred gastroenterostomies he had had four or five hemorrhages. If one sewed the mucosa as a primary layer he prevented hemorrhage. He had been using this method for four or five years with very satisfactory results.

Stated Meeting held January 26, 1921

DR. JOHN A. HARTWELL in the Chair

FUNCTIONAL RESULTS FOLLOWING REMOVAL OF SEMILUNAR BONE

DR. ROYAL WHITMAN presented a man, aged twenty-six years, who had injured his right wrist while cranking an automobile. He had first come under Doctor Whitman's care in July, 1920, about one month after receiving the injury. Examination showed induration on the palmar surface of the wrist. Movements were restricted and painful, the grasp was weak, and there was a tingling sensation in the fingers, evidently due to pressure on the median nerve. At operation a displaced semilunar bone was removed. Now, six months later, function has been completely restored, although the patient thinks the hand slightly weaker than before.

DR. A. S. TAYLOR stated that he had had one case in which he had removed the semilunar bone. Full range of motion returned in six or

seven weeks, but the patient did not have full strength in the wrist for one year.

DOCTOR WHITMAN said that he had seen a number of cases of fracture and displacement of the various carpal bones. Usually operative treatment was refused, and the patient recovered with a somewhat stiffened but fairly useful wrist.

CARCINOMA OF THE TRANSVERSE COLON OPERATED UPON FOUR YEARS AGO

DR. GEORGE WOOLSEY presented a man who was admitted to Bellevue Hospital in February, 1917, at the age of sixty years. His history was that he had been a heavy drinker, but at that time he took only a few glasses of beer a day. He had complained of indigestion for two or three years, had suffered from gastritis a year ago, and since then had had epigastric distress and eructations much aggravated since October, 1916. Recently he had had colicky pains in the epigastrium and in the right side of the abdomen, eructation and occasional difficulty in retaining stools. The trouble was not relieved by taking food. He also complained of dyspnoea and palpitation. He had lost in weight, his weight being only 115 pounds; his average weight was 140 pounds. He had previously had a paralysis of the left side supposed to be due to a "stroke," and he still had some weakness of the left leg. The röntgenographic report was negative. A test meal of 200 c.c. was recovered containing remnants from the previous meal. The total acidity was 13. There was no free HCl; a trace of lactic acid; a trace of Oppler-Boas bacilli; no pepsin. These findings suggested gastric carcinoma. There was a feeling of resistance and an indefinite sense of a mass in the lower epigastrium.

The patient was operated upon on March 6, 1917; the stomach, duodenum and gall-bladder were found normal. The glands along the greater curvature and some in the transverse mesocolon were enlarged, and there was a mass involving the transverse colon with adhesions to the omentum and gastrocolic omentum. The glands were excised and the transverse colon resected in one mass, together with some retroperitoneal glands. The ends were closed and brought together, not in an isoperistaltic but in an antiperistaltic position, and a lateral anastomosis made. The anastomosing ends were then brought so closely together that there was no pouching. He used this method also between the ileum and the large intestine after removal of the carcinoma of the cæcum. The bowel was closed without drainage, and there was no leakage or infection. The mass inside the transverse colon was a scirrhus growth stenosing the lumen of the gut so that it would not admit the passage of a finger. There were scattered enlarged glands in the transverse mesocolon and behind the parietal peritoneum and a queer club-shaped Meckel's diverticulum with three or four projections from the end. The liver showed no metastatic growth. The specimen was pre-

TUBERCULOUS PERITONITIS

sented. The pathologist's report showed an annular, crater-like ulcer with overhanging edges and a firm, indurated base. The microscopic diagnosis was adenocarcinoma.

The convalescence was uneventful. So far as the patient was concerned there was nothing to see but the old scar. He had gained 35 or 40 pounds; he now weighed 140 pounds, his average weight, and was feeling perfectly well at the present time, nearly four years after the operation.

TUBERCULOUS PERITONITIS WITH CANCER OF OVARY (WELL AFTER FOUR YEARS)

DR. CLARENCE A. McWILLIAMS presented a girl, now nineteen years of age, who was admitted to the Presbyterian Hospital in March, 1917. While undressing a month prior, she noticed that her abdomen was swollen. She had never had pain in her abdomen except with her periods, which had always been profuse and painful. Had lost 18 pounds in weight. Never any cough, expectoration, nor indigestion.

On examination her lungs were normal. In the lower part of the abdomen, which was full, there was a suspicion of fluid which did not shift its position. Filling whole lower abdomen, extending to navel, there was a definite, immovable, non-tender, elastic mass. By rectum no masses were felt, but there was fullness in both fornices. A diagnosis was made of ovarian cyst. At the operation on March 24, 1917, there was considerable free abdominal fluid. There was an enormous hypertrophy of all the mesenteric glands, some being as large as lima beans; one was removed for examination. The small intestines were studded with irregular, rough, small masses which looked like papillary cystadenomatous implantations. The right ovary was the seat of a cyst the size of a grapefruit, and the left ovary contained a cyst the size of an apple. The tubes and the appendix seemed normal. The large right ovarian cyst was removed unruptured. The left smaller cyst was also removed unruptured, excising four-fifths of the organ. The appendix was also removed. The liver's surface was normal. The abdomen was flushed with salt solution.

Pathological examination showed the appendix to be normal, an unusual occurrence. The intestinal implantations and the lymph-glands were tuberculous. The left small cyst was found to be a simple cyst, while Drs. William C. Clark and A. P. Stout made a diagnosis of cancer in the large right cyst with many mitoses but little vascularity.

The patient has been seen from time to time in the Follow-up Clinic. In November, 1920, she was perfectly well. Had gained 75 pounds in weight. Was married in November, 1920. Periods have always been regular without pain and not profuse. Examination shows a firm scar with normal abdomen and with no fluid nor masses, nor enlarged glands. By vaginal examination there are no masses nor anything abnormal. The girl is now the picture of health, four years after a laparotomy in which advanced

tuberculous peritonitis was found and from whom a cancerous ovary was removed. The tuberculosis of the peritoneum was the most favorable type for a cure, that with free fluid and without adhesions.

DR. A. S. TAYLOR called attention to the fact that there was some difference of opinion as to the frequency with which tuberculosis and carcinoma were associated. At a recent autopsy Doctor Ewing said that carcinoma in a bronchus usually developed on a tubercular base.

DR. GEORGE H. SEMKEN said, with reference to the infrequent association of tuberculosis and cancer, his experience had not borne out the correctness of that belief. The cervical lymph-nodes removed in cases of cancer of the lip frequently showed tuberculosis as well as cancer; epithelioma often developed on lupus, and lupus was mentioned as tending to predispose, through chronic irritation, to the development of epithelioma. Tuberculin did not inhibit the growth of cancer tissue, and no good theoretical reason could be advanced why tuberculosis should have any influence on carcinoma except to favor its development.

DR. N. W. GREEN stated that Doctor Bastedo had reported cases of tuberculosis of the lungs accompanied by carcinoma in other organs before a meeting of the St. Luke's Hospital Alumni some years ago. He showed the association of cancer and tuberculosis to be sufficiently frequent to be noteworthy. His report, *Medical News*, December 17, 1904, is corroborated by ample literature.

DR. DE WITT STETTEN recalled that in 1909 he had reported two cases of carcinoma and tuberculosis coexisting in the same portion of the intestine. In one of these cases the lesions were at the ileocecal junction and in the other in the lower rectum. In both these cases the history and the pathological examination indicated that the carcinoma grew upon the tuberculosis and was, in fact, induced by the chronic irritation of the latter disease. It was, he thought, due to the teaching of the Rokitansky school, that the idea that carcinoma and tuberculosis were mutually antagonistic had gained credence, but that to-day this view had been pretty generally disproved and discarded. Indeed, in certain instances, such as in his two cases, quite the reverse might be the case, and the local tuberculosis might lead eventually to the cancerous condition.

CARCINOMA OF PYLORUS, PARTIAL GASTRECTOMY UNDER LOCAL ANÆSTHESIA

DR. GEORGE H. SEMKEN presented a woman, aged forty-nine years, who came under his observation on June 6, 1920. Since early adolescence she had had occasional attacks of pyrosis following diet indiscretions, but there had been no definite "indigestion" until four years previously. The gastric disturbance since that time had been continuous. It began with epigastric pressure, borborygmi, and eructations of gas. Later, there was added the escape of a quantity of clear, tasteless, watery fluid from the mouth. These symptoms had been progressive and had become

PARTIAL GASTRECTOMY UNDER LOCAL ANÆSTHESIA

more severe. At no time had there been abdominal pain, nausea, or spontaneous vomiting. She had lived on liquid diet for the last year, had lost forty pounds in weight, and had become very weak.

Objectively the patient showed considerable emaciation and asthenia; there was a palpable, apparently movable mass above and to the right of the umbilicus; the stomach was enlarged and showed visible peristalsis but no splashing. The examination of the stomach contents showed free HCl 59, and total acidity 98 before the Ewald test breakfast, and free HCl 28, with total acidity 59 after the meal. Both showed much mucus and little blood. Opplér-Boas bacilli and lactic acid were not reported. The X-ray examination showed an annular growth in the lower third of the stomach that presented all the characteristics of malignancy. There was marked retention, about three-quarters of the meal remaining in the stomach after twenty-four hours. The Wassermann was negative.

At the time of operation on June 10, 1920, owing to the markedly asthenic condition of the patient, it was planned to begin with local anæsthesia (novocain) and to continue with it as long as that was feasible. In addition to the infiltration of the abdominal wall it was necessary to infiltrate the region about the pancreas. No further anæsthesia was necessary and the patient bore the operation very well, though with some discomfort.

A fibrosed carcinomatous ulcer was found at the pylorus which had produced almost complete occlusion and a secondary, considerable enlargement of the stomach. The tumor was adherent posteriorly to the pancreas; there were some enlarged nodes in the gastric colonic omentum and also along the lesser curvature, but none were found at the uppermost level. Adhesions between the upper surface of the liver and the diaphragm evidenced a previous inflammation. No other pathological changes were found.

The partial gastrectomy, taking about two-thirds of the stomach, was done, following the Billroth No. 2 technic. Aside from a transitory albuminuria with casts that continued for a few days, the patient made an uneventful recovery and was able to leave the hospital seventeen days after the operation. Her progress has been excellent since that time; she regained her normal weight and has no gastric disturbances.

DR. GEORGE WOOLSEY said he had not had occasion to resect a stomach under local anæsthesia, but he had done a gastroenterostomy under local anæsthesia. Provided the patient was not too stout it was easy for the patient and the surgeon. If the patient was stout it was almost unavoidable that one should make some traction on the posterior parietal peritoneum that would be painful. Abdominal operations could be readily done under local anæsthesia provided the patient was not too stout.

DR. ALLEN O. WHIPPLE said there was one indication where local anæsthesia worked unusually well. He had had two cases of cardiac disease in which general anæsthesia was out of the question. One of these

was thought to be a carcinoma of the pylorus which proved at operation to be an ulcer, and a gastroenterostomy was done under local anæsthesia without any real distress to the patient. The patient, who was a very intelligent man, was very much surprised that he experienced so little pain. The other case was one with disease of the common duct and a cholecystectomy and choledochostomy was performed under local anæsthesia. Both of these patients were fibrillators, and neither of them had fibrillation following operation. That was unusual, and if they had been given general anæsthesia they would very likely have had fibrillation.

DR. N. W. GREEN thought there was a class of patients that could be saved if operated upon under local anæsthesia which would die with increased blood urea nitrogen or acidosis under general anæsthesia. When the blood urea nitrogen was as high as 35, 40 or 50, general anæsthesia might be considered unsafe, but operations could safely be done under local anæsthesia. The strain on the surgeon was much greater when local anæsthesia was employed because he had to work more slowly and more carefully, and he could not operate upon as many patients in the same time as with general anæsthesia; but he felt that one could save some patients by the use of local anæsthesia that could not be saved if general anæsthesia were used.

DR. A. V. MOSCHCOWITZ said that up to within a very short while he had been doing both lobectomies and subtotal thyroidectomy with local anæsthesia. He was under the impression that he was particularly courageous to do so, because the operation took a long time and had to be done very slowly. Since a recent visit to Doctor Crile's clinic, Doctor Moschcowitz had changed his technic in so far that he had discarded a purely local anæsthesia, and had performed all subtotal thyroidectomies in general anæsthesia, *i.e.*, under laughing gas, aided by a small quantity of ether. He had learned to perform the operation in one-third of the time it formerly took him. He had also found that patients stood this anæsthesia and operation perfectly well; in fact, he had operated cases of pronounced cardiac arrhythmia, and had found that subsequent to the operation this arrhythmia disappeared.

DR. JOHN R. HARTWELL said he felt that in the use of local anæsthesia the suffering was not only on the part of the patient but on that of the surgeon. If the patient was given a preliminary dose of morphine, and the room was quiet and the patient encouraged not to be panicky, almost any operation, a partial gastrectomy, gastroenterostomy, cholecystectomy, etc., could be done under local anæsthesia. It was being used more and more. It was a question of being willing to take the additional time and care and the additional mental effort and strain, but he believed it had a great advantage in that it required the surgeon to do very careful and neat work; the patient would not allow him to do otherwise. From the educational standpoint, the increased use of local anæsthesia had a very beneficial effect all along the line. It was surprising

LATE SUTURE OF THE MUSCULOSPIRAL NERVE

how much could be done under local anæsthesia. Of course, with the use of paravertebral and spinal anæsthesia the field of local anæsthesia was still further extended.

DR. SEMKEN stated that the success of local anæsthesia in abdominal operations depended largely upon a proper teamwork between the operator and the patient. A preliminary hypodermic injection of morphine was considered essential. A preliminary explanatory talk with the patient was just as essential; he should be informed as to just what he would feel and how severe it would be. The handling of viscera must necessarily be gentle and no sudden movement of retractors or sudden traction upon the viscera should be made.

The patient whose case was presented had a high degree of acidosis through inanition. The transitional nephritis that followed the operation was highly suggestive. It was interesting to consider what effect an ether narcosis might have had in this case.

With reference to Doctor Moschcowitz's remarks concerning his preference for ether narcosis in thyroidectomies, Doctor Semken suggested that Doctor Moschcowitz would probably have even better results if he would use ether colonic anæsthesia in those cases.

LATE SUTURE OF THE MUSCULOSPIRAL NERVE

DR. JOHN A. HARTWELL presented a man, aged twenty-eight years, who, on May 4, 1920, received a stab wound in the left arm above the elbow-joint. The knife passed from the outer side of the arm, above the external condylar ridge, downward, forward and inward and emerged on the inner aspect of the arm just above the inner epicondyle. Examination failed to show that the sensory distribution of the musculospiral nerve was involved. There was noted disability in the distribution of the extensor muscles to the wrist and hand which was referred to the fact that the muscles themselves were extensively cut by the stab wound. The wound was cared for in the usual manner and healed promptly, patient having left the hospital at his own request, eight days after the injury. He returned to the follow-up clinic on June 14th, when the following note was made: "The extensor muscles of the forearm show atrophy. There is a complete loss of power to extend the wrist or to adduct it. There is also loss of power in the extensor muscles of the fingers. Pronation and supination are normal. There is a partial loss of pain and tactile sense over the posterior portion of the thumb and the web between it and the index finger. The condition is evidently a complete severance of the musculospiral nerve."

Operation was performed June 18th, forty-five days after injury, at which time there was found a complete severance of the nerve one inch above its division into the two main branches. Each end presented the usual end-bulb about one-half inch in length. The nerve was exposed in its passage around the humerus and followed downward to its bulb-

ous end. An incision was then carried downward and curved a little forward into the substance of the extensor group of muscles, where the distal bulb was found buried in a dense scar tissue. The nerve was thoroughly freed in both directions. All scar tissue was dissected away so as to make a clean muscular bed for the nerve. The bulbous ends were cut off and the sections carried back carefully into the normal nerve fasciculi were plainly distinguishable and the "blood sweating" appeared. These conditions demonstrate that normal nerve tissue has been reached. The interval between the two ends was not more than two inches, and by flexing the forearm to 100 degrees the nerve-ends were brought into apposition without resorting to stretching and were very carefully sutured with the finest silk stitches, penetrating only the perineural sheath so that at the termination of the suture all the fasciculi were well within this sheath. Care had been taken throughout to maintain the proximal and distal segments in the natural relation of the nerve-fibres, so that so far as possible proximal fasciculi were in contact with the proper distal fasciculi. The nerve-bed was reestablished by resuturing the muscles with plain catgut. It was noted that the forearm could be moved through an arc of from 100 degrees to 90 degrees flexion without putting any tension on the nerve. The arm was, therefore, put up in a moulded splint about 95 degrees flexion at the elbow and complete dorsal flexion at the wrist. Healing of the wound took place by primary union. At the end of two weeks the splint was removed daily and the arm carried through a passive motion of 15 degrees. This procedure was continued until the end of five weeks after operation. It has been shown experimentally by Dean Lewis' staff that at this time nerve union is firm. The splint was, therefore, removed and the patient was given a cock-up splint for the wrist and told to passively and actively move the elbow. During the following weeks he had massage, and on the ninetieth day, post-operative, he stated that he could feel power returning to the paralyzed muscles. Thereafter all splints were removed, and he was instructed to actively engage in reëducation of the muscles. His improvement since then has been rapid, and at the present time it is difficult to recognize that the arm has ever been cut.

There are two points of interest in this case. First, that the examination of a suspected injury of the musculospiral nerve must be carried out with extreme care because of the fact that its sensory distribution is so overlapped in many cases by the median and ulnar nerves that the anæsthetic area is exceedingly small. In this case it was overlooked, the note being made that there was no apparent disturbance in sensation. Further, if the injury involves the muscles, it is difficult to differentiate the resulting disability from that due to muscle injury itself, as in this case.

The second point of interest lies in the fact that one can so accurately determine the probable time of return of power. It is estimated that the distance from the severed nerve to the upper muscular distribution is

LATE SUTURE OF ULNAR NERVE

between 90 and 100 mm. and it is exactly at this period that the power began to return. From that time the power steadily improved as the more distant portions of the muscle were reached by the ongrowing nerve fasciculi. This fact proves the proximal and distal segments were laid *in their normal relation*, because it has been demonstrated that the regeneration and reëducation of the nerves and muscles is delayed if upper fasciculi and lower fasciculi are not in proper contact.

LATE SUTURE OF ULNAR NERVE

DOCTOR HARTWELL also presented a woman, aged twenty-five years, who was struck by an automobile on September 2, 1920. She had multiple injuries about the face and body, all of which were exceedingly lacerated and very dirty. One wound was in the left forearm, along the inner surface at about its middle, where there was about three inches of lacerated muscle exposed, and a posterior wound opposite this on the outer side on the back of the forearm. The wounds were all treated by *débridement* and sutured. There was no note made as to sensation of the hand in this case, and again the muscular disability was assumed to be due to the loss of muscle substance. The ulnar nerve was not seen in the operation, and it was only discovered at the end of a week that it had been severed. There was a certain amount of suppuration in the forearm, so the repair of the nerve was delayed until November 5, 1920, sixty-three days after the injury, for fear of a secondary infection taking place. At the operation the nerve was found divided about four to five inches above the annular ligament, where the two ends were found lying in very dense scar tissue representing the repair of the damaged flexor carpi ulnaris muscle. The same procedure was followed as in the preceding case, and because of the extensive scar tissue and bulb formation a defect of three inches existed. In order to overcome this it was necessary to free the ulnar nerve from its bed to well above the epicondyle. By continued gentle traction on the nerve at an estimated pull of about five pounds it was in ten minutes sufficiently stretched to gain the necessary three inches. Suture was then carried out in the same manner as described and the soft parts were similarly repaired. It was found that the nerve could be replaced behind the internal condyle without tension on the suture line, and this was accordingly done. It is estimated that the distance from the suture to the muscles of the hand was seventy-five mm., so that we should now find returning power in these muscles if our suture was accurately applied.

A second factor, however, may be present in this case, in that the nerve was so extensively stretched. It is possible that regeneration may be delayed by this procedure, though we have seen no comment in the literature on this point. A further report showing the final outcome in this case will be made.

DR. ROBERT T. MORRIS, asked, in reference to the musculospiral nerve

regaining its function, whether it might not be true that delayed sensation in the thumb was due to the radial nerve being left out of the suture line. The radial nerve sometimes left the musculospiral higher up than the site of the stab wound in this case. Would a fat graft have helped avoid interposition of connective-tissue cells between cut ends of the radial fasciculus?

DR. A. S. TAYLOR said, in regard to the ulnar nerve, it seemed to him a question whether traction involving elongation 30 to 50 per cent. of the involved nerve was desirable. He thought it had been demonstrated that pulling on the nerve would stretch the nerve-sheaths and tubules, but was apt to crack the axis cylinders, and this would certainly delay recovery. Transposition of the ulnar nerve to the anterior aspect of the elbow would give increased length and had been done with most prompt and satisfactory results.

As to the fat graft suggested in the discussion, Major Huber had found that it degenerated into cicatricial tissue which constricted the enclosed nerve and that regeneration of the nerve was better if normal muscle was used as a new bed for the nerve.

DOCTOR HARTWELL said that his first effort was to suture the nerve without stretching, but after it was dissected free as far as was practicable it was still three inches short, and placing it in front of the condyle did not seem to be of much advantage.

NON-TUBERCULOUS INFLAMMATION OF CÆCUM

DR. JOHN A. HARTWELL presented a boy, aged fourteen years, who was admitted to the hospital November 27, 1920, with evidence of a chronic lesion in the right iliac fossa, an acute exacerbation of which was present. He was an Italian and at the time was pale and undernourished, pointing to the possibility of a tubercular infection. Under anæsthesia a distinct tumor could be felt in connection with the cæcum. The specimen showed a very extensive inflammatory process involving the appendix, the cæcum, and a small portion of the ileum. The cecal wall is thickened to more than one-half inch, and at the time of operation it was impossible to determine whether the condition was tubercular or not. The regional lymph-node was involved, but there was an absence of any miliary tuberculosis. The wisest procedure seemed to indicate a resection of the bowel, with the probability that tuberculosis was present. This was done in the usual manner and the lateral anastomosis made between the ileum and the first part of the transverse colon, with the closed ends both pointing toward the right. The closure all seemed satisfactory and no drainage was used, though the omentum was so placed that in place of leakage the discharge would find its way to the abdominal incision. This occurred and a small fecal fistula was present, but is practically healed at the present time.

The interest in this case is the fact that a very careful examination of

the appendix and cæcum fails to show any positive evidence of tuberculosis, though Doctor Hartwell said he was not willing to say that this was excluded, as referring to the paper read by Dr. Seward Erdman last year demonstrated the difficulty of always finding tubercular tissue in these lesions even though it is present. The second point of interest was the type of anastomosis that should be made in these cases; that was, whether leakage was less apt to occur in either an end-to-end or end-to-side anastomosis, or a side-to-side anastomosis as here used, and also whether any especial attention should be paid to the relation of the anastomosis to the longitudinal band on the large intestine.

DR. SEWARD ERDMAN said as to the case of non-tuberculous inflammation of the cæcum, that he had reported a similar case last year, and he felt that the follow-up would solve the question and the case might prove to be one of tuberculosis. He had been looking up the literature of the subject and had been impressed by the fact that a number of cases in which no tuberculosis was demonstrated in the pathological specimen at first, nevertheless later examination and the course of the case proved tuberculosis. Apparently the consensus of opinion was in favor of the side-to-side anastomosis of small intestine to colon, although some surgeons used the end-to-end anastomosis. Of course, the side-to-side anastomosis had certain advantages; it took a little longer, but there was never a question of blood-supply as there was always a perfectly good blood-supply around the stoma; there was also plenty of serous apposition surrounding the anastomosis, and both of these were lacking in the end-to-end or end-to-side anastomosis.

DR. GEORGE WOOLSEY said, with reference to anastomosis of the two ends of the large intestine, if one end was much larger than the other they were not well suited to end-to-end anastomosis. In the case he had presented the proximal end was not enormously distended, so there was not a great difference between the two ends. One could make as large a stoma as he wished with a side-to-side anastomosis. There was one advantage in bringing the two ends together, fastening them side by side and making an antiperistaltic anastomosis, and that was that it left less pouching, whereas if one had an isoperistaltic anastomosis there was more tendency to pouching of the blind ends.

This patient he had presented and he did not drain the wound at all but sewed it up tight. Except where he had not put in a drain he had been compelled to drain afterward. So far as the longitudinal band was concerned, he had not avoided it in making an anastomosis, and he thought he would rather choose a band because it made a smoother surface.

DR. SEMKEN stated, with reference to Doctor Hartwell's question concerning the best form of anastomosis to be used in resections of the colon, that the last publications from the European clinics, as well as those in the United States, seem to favor a return to the end-to-end method. The unfortunate results obtained in many of these cases in former times were

ascribable to necrosis of the margin of the gut segments. Lockhart-Mummery had called attention to the vascular supply of the colon in explanation of this occurrence. The vessels were radial and ended in a radial ring about the circumference of the gut. The mesenteric stitch often caught this terminal vessel and cut off the supply of blood from the edge of the intestine. To obviate this, Lockhart-Mummery advised an oblique cutting of the gut instead of the usual transverse division. This suggestion was advanced many years ago as a method of increasing the lumen of the gut at the site of the anastomosis and minimizing the danger of post-operative contracture. Horsley and Soresi called attention to the danger of infection of the small triangular space at the mesenteric junction, and advised the closure of this space before the intestine is opened.

The Mayos had made the excellent suggestion of slightly rotating one segment of the gut about its long axis to bring the mesenteric junction points at different places, so that there would always be at least one serous surface in the anastomosis at all points. As to the relative values of iso- and antiperistalsis in the placing of the intestinal segments in lateral anastomosis, it had been shown by Schmieden that the gut evidently soon transforms all of these into a relatively straight canal; but it was important that no blind pouch be left.

In cases of resection or cancer of the colon the most important point in the technic was the removal of the related lymph-nodes.

ULCER OF STOMACH—HODGKIN'S DISEASE

DR. JOHN A. HARTWELL presented a man, aged forty-five years, who was admitted to the hospital February 7, 1920, giving an indefinite history of gastric disturbance extending over a period of years and which has become very marked during the last nine months. During this latter period he had had some gastric pain coming on from one-half to two hours after eating and on several occasions has vomited large quantities of blood. He had also passed blood by stool. At the time of his admission he was much under weight and showed loss of blood. The X-ray examination showed a disturbance of function around the pylorus which at operation was found to be due to perigastric adhesions in which the gall-bladder seemed to be the exciting cause. X-ray failed to show an ulcer which at operation was found on the anterior surface of the stomach, at the junction of the cardiac and middle thirds. This ulcer was about one and one-half inches in diameter, had a hard, distinct border, but showed no tendency to perforate the stomach wall. The operative procedure consisted in a cholecystectomy and release of the pylorus from the rather extensive but recent adhesions which were found and an excision of the ulcer with local repair. The lumen of the stomach seemed to be well established after this procedure, and consequently no gastroenterostomy was performed, though it was thought that either this or a

ULCER OF THE STOMACH—HODGKIN'S DISEASE

gastrogastrotomy might be later required. This had proved not to be the case, as the patient is now in good condition. The X-ray showed the stomach functioning well, and he had gained some thirty pounds in weight. He still, however, suffered from some mild gastric symptoms which were easily controlled by regulation of diet.

The pathological report on the ulcer, Doctor Hartwell said, was the matter of interest in this case, the gross specimen consisting of a gastric ulcer with a narrow rim of stomach surrounding it. The actual ulcer was about one inch in diameter. Its margins were irregular and scalloped and in some parts undermined. The base was formed by a firm, fibrous-like tissue about 1 cm. in thickness. Peritoneal covering on this point was reported as having been removed, but was not involved. Sections of the ulcer showed extensive thickening of the mucosa and submucosa in the involved area by round-celled infiltration. The round-cells were closely packed together and septa of fibrous tissue divided the infiltrated area into coarse lobules. The glandular tubules of the mucosa were almost completely destroyed. The muscular coat was involved in a very slight degree. Some of the vessels, however, showed marked sclerosis with perivascular round-celled infiltration. The mucosa at the margin of the ulcer showed cystic dilation of some of the glandular tubules but was otherwise about normal. *Diagnosis:* Chronic gastric ulcer, possible tuberculosis or syphilis.

Sections were made and stained with carbol-fuchsin and by the Levaditi method, but no tubercle bacilli nor spirochaetes could be found. A section of the tissue was submitted to Dr. Charles Norris for examination without knowledge of its origin. He pronounced the histology that of Hodgkin's disease, but was unwilling to say positively that it should be so classified. Dr. James Ewing was of a similar opinion, giving the diagnosis of infectious granuloma, but was unwilling to rule out malignancy by the sections he saw, as there are certain areas in which epithelial-like cells were found penetrating into the substance of the granuloma. The section was presented for inspection.

So far as discovered the literature showed only a few cases of Hodgkin's disease of the stomach, though it was found in the intestinal lymphoid tissue. An examination of the chest of the patient failed to show mediastinal lymph-nodes and up to the present time there was no evidence that he had other foci of Hodgkin's disease.

The question was well summed up in "Ewing's Neoplastic Diseases, 1919," as follows:

"Gastro-intestinal Hodgkin's granuloma is an ill-defined condition difficult to separate from tuberculosis, on the one hand, and lymphosarcoma, on the other. The group of diffuse lymphomas affecting a large portion of or the entire gastro-intestinal mucosa (Stoerk, Wells, Symmers) must, I believe, be given a separate position, since they differ widely in structure and distribution from typical Hodgkin's granuloma.

There remains a considerable group of locally destructive hyperplastic lesions located in any portion of the gastro-intestinal tract, especially in stomach, ileum, and cæcum, in which the structure is distinctly granulomatous and in which tubercle bacilli are missing. I have studied several cases of this type, with local ulceration and extensive swelling of regional nodes, in which the lesions resembled Hodgkin's granuloma. Coupland and LaRoy have described typical cases, but reports in the literature are scanty, since most of the cases are interpreted as lymphosarcoma."

DR. JOHN DOUGLAS said that in looking up the literature of sarcoma of the stomach when he read a paper on this subject before the society a year ago, he had found that the majority of intrinsic disseminating sarcomas of the stomach which were reported were of the lymphosarcoma type.

So far as the pathology of Hodgkin's disease and lymphosarcoma were concerned, though he was not a pathological expert, he thought that the microscopical appearances of the two conditions were so similar, the fact that at the end of a year this patient showed no signs of Hodgkin's disease elsewhere, indicated that he should be classed with the lymphosarcomas. He believed that in all probability the reported cases of lymphosarcoma and Hodgkin's disease of the stomach were of the same nature.

DOCTOR HARTWELL said that Doctor Ewing's statement was that many cases that appeared in the literature among lymphosarcoma belonged to Hodgkin's type of disease if there was any difference between the two.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna

ANNALS *of* SURGERY

VOL. LXXIII

JUNE, 1921

No. 6.

A GRAVIMETRIC METHOD FOR DETERMINING THE SUPERFICIAL AREA OF WOUNDS

(A PRELIMINARY REPORT)

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THE contributions of Carrel, Dakin, and Dehelly in France and of the War Demonstration Hospital in New York City on the rate of wound healing as influenced by different surgical methods and various antiseptics were especially noteworthy during the war. They have emphasized the need of exact quantitative as well as qualitative standards in estimating the value of any antiseptic procedure.

In the following report a method is presented for the quantitative study of the healing of surface wounds. This, in the light of experiments made during the last eight months at the Johns Hopkins and New Haven hospitals, indicates a distinct advance in the simplification of the methods commonly employed. *Rubber protective tissue, bond paper, and a chemical balance* are the only essentials with this technic. Thus the expense and complexity of the planimetric method as employed by Carrel and du Noüy is avoided. The effort in this technic is to dispense with the planimeter and substitute for it an estimation of the area of a wound by weight, obtained by transferring its contour through carbon paper to a standard sheet of paper of known size and weight. It is then a simple matter to cut out this area from the sheet and after weighing it to determine by a simple process of proportion the exact area of the wound. The steps in the method are as follows: To obtain the contour of a wound the author recommends a thin sheet of rubber protective tissue, cellosilk or cellophane film. Next sterilize the edges of the wound with alcohol, bichloride, or iodine. Place the sheet of pliable transparent material in contact with its surface. Trace the exact outline of the granulating surface or of the unpigmented epithelium with a marking pencil or pen, or cut it out directly with pointed scissors (Fig. 1). Place the pattern after cleansing it over a sheet of standard history paper or other bond paper to which its outline is traced in ink, or transferred through carbon paper. The weight of this sheet is next obtained on an accurate balance, such as one finds in any hospital, laboratory or druggist's (Fig. 2). Finally, the traced pattern is carefully cut out and weighed. With the area of the whole sheet, its weight and the weight of the cut-out pattern known, then by simple proportion: Weight of the whole sheet is to the weight of

the pattern of the wound as the area of the whole sheet is to the area of the wound. This may be expressed in the following formula:

$$\begin{aligned} & \text{WS : WCO :: Area S : CO} \\ \text{where } & \text{WS} = \text{the weight of the whole sheet,} \\ & \text{WCO} = \text{the weight of cutout,} \\ \text{Area } & \text{S} = \text{area of the whole sheet, which is known,} \\ \text{Area } & \text{CO} = \text{the area of the cutout or the area of the wound} \\ & \text{to be determined.} \end{aligned}$$

Substituting figures, for example, from an actual case, we have

$$\begin{aligned} 3.4856 \text{ gms.} : 1 \text{ gm.} &:: 576.64 : \text{CO} \\ \text{CO} &= 165.43 \text{ sq. cm.} \end{aligned}$$

If many determinations are to be made the method is simplified by a preliminary calculation of the constant of weight per square centimetre of the paper used. This makes necessary only the weighing of the pattern of the wound to determine its area by simple division. If the wound is on a plane surface its pattern may be obtained photographically and enlarged to life size for tracing.

Two precautions should be observed in making tracings. (1) The size of paper should not be out of proportion to that of the area to be traced. The reason is obviously to avoid even the slight error due to variation in thickness of sheets. Standard typewriter size is the one usually found convenient for use on surface wounds of average size. (2) Before and during the weighing of the final tracing the latter should be protected from finger marks and dirt for, on a delicate balance, these factors introduce an appreciable error.

The tracing material must be pliable enough to conform to the irregularities of the surface. Valuable suggestions in this connection have been made by Dr. Mont R. Reid and Professor Halsted. In a test of materials for this purpose, protective rubber tissue apparently stands first in convenience; cellosilk or cellophane film rate second, while paraffine paper possesses distinct drawbacks on account of its relative inelasticity and the difficulty of marking upon it. The tracing materials are kept sterile in bichloride or other antiseptic.

Factors of Error.—It often happens that a method in the hands of one investigator yields excellent results, while in the hands of another they are not so encouraging. This may be obviated with gravimetric determinations of wound areas if one is thoroughly familiar with the possible sources of error.

The error due to variation in the thickness of various parts of the paper was first estimated by using five different bond papers chosen at random, squares of known area (25 sq. cm.) were cut from opposite corners and weighed. Though the squares were only cut by hand, their calculated and actual areas showed a difference of only 1.04 per cent. From these experiments it would appear, then, that from the variations in the thickness of individual sheets a practically negligible error may be anticipated.

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It is important to know, however, what variables may be obtained in using different grades and weights of papers; for naturally it is often convenient to use different kinds of paper. Six commonly employed bond papers were used to calculate unknown areas. The results in tabulated form are as follows:

TABLE I

	Known area, sq. cm.	Weight whole, grams.	Known area, sq. cm.	Calculated weight	Calculated area	Error, per cent.
O. H. Bond.....	300	1.9795	100	.6715	101.7	1.70
L. Bond.....	300	2.204	100	.7205	98.5	1.50
Ruled K. Bond.....	300	1.897	100	.6407	101.0	1.00
Ruled H. B.....	75	.483	25	.1587	24.43	2.28
L. Bond.....	75	.54025	25	.1795	24.92	.32
Ag. Bond.....	100	.558	1	.055	1.0	.00.
K. Bond.....	300	2.2064	100	.7205	101.7	1.70
O. H. Bond.....	75	.503	25	.1687	24.99	.04
K. Bond.....	300	1.897	100	.6407	101.0	1.00
Average error.....	....	....	....	....	....	1.06

Here again it is noted that the error is only 1 per cent., while the maximum possible variation in this series is approximately 2 per cent.

In weighing and measuring the area of successive sheets of the same paper it was accidentally noticed that when a lot of loose sheets indiscriminately collected were used the results varied widely. The following table gives the weight variations in such a series:

TABLE II

WHOLE SHEETS

Ag. bond	Ruled K. bond	Unruled bond
3.644	4.401	5.702
3.660	4.672	5.338
3.412	4.3765	5.2755
3.405	4.220	5.335

Analysis of these variations showed that the difference in weight was due to a difference in size. *The weight, in other words, was almost exactly proportional to the size, and the variation in weight resulted from the very great inaccuracy of cutting the original sheets.* When this error was deducted, the differences due to uneven thicknesses of various sheets and different parts of the same sheet were found to be so slight that they were for all practical purposes negligible. In an effort to eliminate the error due to inaccurate cutting, a very important simplification of the method was devised. Apparently, for ordinary commercial purposes, variations in size of ordinary bond papers of 1/16 of an inch in either dimension are unimportant, and accordingly no particular care is taken in the cutting. When, however, accurately cut sheets are desired, any

first-class paper house can provide them so that they do not vary more than .04 cm. The weights correspond closely to the size.

It is this close proportion of weight to area in sheets cut with accuracy which introduced the most important simplification of the gravimetric method, *viz.*, the constant of $\frac{\text{weight}}{\text{area}}$, or weight per square centimetre.

The simple determination of this constant for a few sheets of paper reduces the calculation of the unknown area of the cut-out of a wound to a process of numerical division. If the weight per square centimetre of any paper is known, it is only necessary to weigh the cut-out tracing, and divide it by this constant to obtain the area of the pattern which is, of course, the area of the wound. In order to test the feasibility of *utilizing such a constant*, two accurately cut bond papers were employed. For our purpose, Old H 16-pound bond, costing \$6.50 per ream, gave the best results. The weights of sixteen sheets were carefully taken. The areas of each were calculated. The former divided by the latter gave the constants of $\frac{\text{weight}}{\text{area}}$, yielding an average constant of .005834 gm. per sq. cm.

of surface for this paper. The smallest constant differed from the average by less than .000072 gm.; the largest constant varied from the average by less than .000090. In measuring an area of 35 sq. cm. this would mean a maximum error of .54 sq. cm. If, for instance, an observer took the measurements and weights of any four of a series of 500 sheets, and, at the same time, should happen to select the four lightest sheets for the determination, and, in addition, should employ for his tracings the very heaviest of the remaining sheets without measuring or weighing it, his $\frac{\text{weight}}{\text{area}}$ factor would then (in the above series) be .005777, while the constant of his tracing = .005924. The error, therefore, would be .000147, amounting in a surface of 35 sq. cm. to only 2.3 per cent., or .882 cm. This would be the maximum error for any one determination.

If, on the other hand, he made two sample tracings or a series of determinations on successive sheets, the variable for the whole would be rapidly reduced to the .35 of 1 per cent. The following table emphasizes the progressive reduction of the error incurred by using a constant calculated from one to sixteen sheets:

TABLE III

Using constant calculated from	Greatest possible error
1 sheet	2.7 per cent.
2 sheets	2.6 per cent.
4 sheets	2.3 per cent.
8 sheets	2.1 per cent.
12 sheets	1.7 per cent.
16 sheets	1.5 per cent.



FIG. 1.—Method of taking a pattern of a wound surface by means of a direct cut-out from semi-transparent rubber tissue.

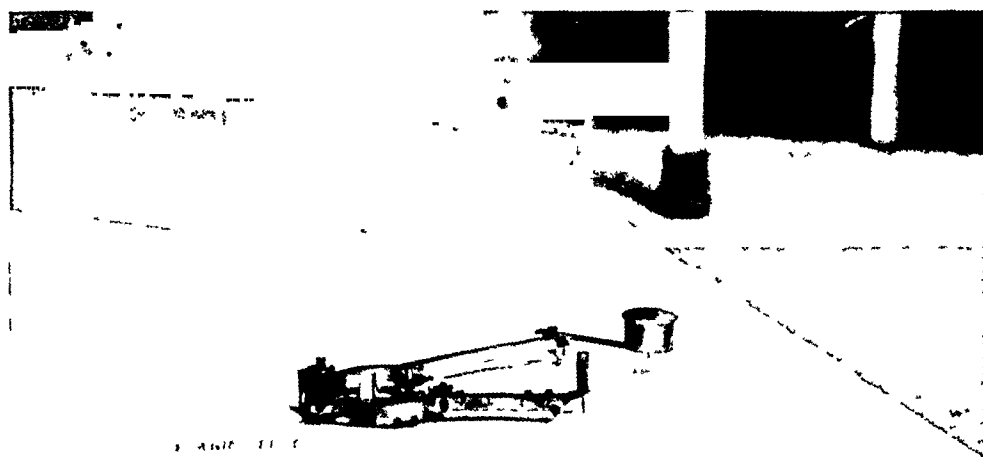


FIG. 2.—Planimeter placed upon an outline the areas of which is being estimated by its use.



FIG. 3.—The weighing of a wound pattern by the gravimetric method. The standard bond sheet from which it was cut is shown at one side.

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If, however, a couple of tracings from the same pattern are made on different sheets and are cut out and weighed, the average of results will reduce the possible error to 1 per cent. If four are made the error will be only .35 of 1 per cent., etc. If still greater accuracy is desired, it may be obtained by making three or four determinations of each tracing and using a sixteen-sheet constant. This will occupy only a slightly longer time. While it is possible that the accuracy may be increased by using an extremely expensive paper, the one which we have employed has failed to improve the results. If only reasonably accurate results are desired, one may compute the weight and area of only four out of five hundred sheets for the $\frac{\text{weight}}{\text{area}}$ constant, and take a single reading of the scales for each tracing.

In this study of the variables and errors inherent in the gravimetric method, it will be seen that they average a little over 1 per cent. A method, like a chain, is no stronger than its weakest link. But, as a matter of fact, the errors in the determination of wound area by this technic are less than those probable in taking the original tracing of the wound. To know what this factor might be, the following experiments were performed.

Three persons familiar with ward work traced in ink on cellosilk film the pattern of a convex cicatrizing burn in the thigh. Though the tracings were made in the same hour under similar conditions, yet the variation in results was greater than 3 per cent.

TABULATION OF AREAS OBTAINED BY THREE DIFFERENT PERSONS

No. 1	No. 2	No. 3	Greatest Variation
54.95 sq. cm.	54.68 sq. cm.	53.22 sq. cm.	3.1 per cent.

Subsequent to this one person made three consecutive tracings of a cicatrizing varicose ulcer of the leg. The results show a variation of 1.06 per cent.

TABULATION OF AREAS OF THREE TRACINGS BY ONE PERSON

No. 1	No. 2	No. 3	Greatest Variation
40.79 sq. cm.	40.36 sq. cm.	40.62 sq. cm.	1.06 per cent.

The errors of the original tracing, a stage common to estimations by both the planimetric and gravimetric methods are greater than the errors inherent in either of them. Of course, such variables may be cumulative, but it is improbable, in the ordinary laws of chance, that they would affect the results in the same way. In general one would tend to correct the other.

Comparison with Results Obtained by Planimeter.—The planimeter employed in this study for comparative area determinations by the two methods was one of the finer instruments¹ loaned by Professor Tracy of

the Sheffield Scientific School of the University. A planimeter such as that employed by du Noüy for computing the area of his tracings means an initial outlay of between fifty and sixty dollars. It is an instrument of precision and therefore requires attention to maintain its accuracy. The only apparatus required for the gravimetric method is, first, a pair of shears, and secondly, a delicate balance similar to those universally employed in hospitals, laboratories, and drug stores. A good quality of bond paper for tracings is essential to both methods.

With the planimeter one freehand tracing must be made with scrupulous accuracy. In the gravimetric determination one weighing must be done with great care. *It is much more difficult to trace accurately than to weigh accurately.* The planimeter must be set up and taken down, which would be equivalent to the time consumed by the simple arithmetical calculation necessary with the gravimetric system. The determination of the constant of $\frac{\text{weight}}{\text{area}}$ is simple if a number of sheets are weighed to-

gether and divided by the number weighed. This forms the numerator of the constant, while the average of the size of four or more accurately cut sheets forms the denominator. Once this is done enough paper is calibrated for more than an average year's work.

The gravimetric method offers one more advantage over the planimeter, *viz.*, much larger areas may be measured with equal accuracy. The planimeter will accommodate only a 10-inch square, while the gravimetric method will measure an extremely large tracing as easily and as accurately as a small.

For purposes of direct comparison six determinations made by the gravimetric method were checked with planimetric determinations. The results are given in the following table:

TABLE IV

Case	Area by gravimetric method	Area by planimeter	Percentage variation
I.			
Carbuncle of neck:			
Dec. 12, 1918.....	25.95	25.74	.9
Dec. 27, 1918.....	52.07	51.99	.16
II.			
A. J. Ulcer of leg:			
Feb. 19, 1919.....	172.40	172.77	.2
Feb. 29, 1919.....	178.75	179.55	.5
III.			
E. S. Burn arm:			
Dec. 3, 1919.....	145.85	146.96	.9
	130.09	130.19	.07

These cases are cited to show that even with the crude paper and poor technic used more than a year ago, the results compared very closely

DETERMINING SUPERFICIAL AREA OF WOUNDS

with those obtained with the more expensive planimeter. In order to obtain an absolute check as to the accuracy of the two methods the following procedure was adopted: Six sheets of paper of wide variation in size and weight were selected as test sheets. With the assistance of Doctor Moise, these sheets were placed on a plane surface with a sheet of tracing paper and of bond paper under them. An arbitrary tracing with the planimeter was outlined on each one by two persons and a reading recorded for each. The copy made by the tracing paper was then carefully run over again by each observer, giving, of course, a slight difference which may be termed the error of tracing by hand with the planimeter. The dimensions of each sheet were then measured to get the area. Finally the outlined areas were cut out and weighed to determine the area by the gravimetric method.

TABLE V
TABLE OF RESULTS

No.	Absolute area, sq. cm.	Planimetric R. sq. cm.	Per cent. error	Gravimetric R. sq. cm.	Per cent. error	Difference
1	35.48	35.70	.6	35.86	1.06	
2	38.32	38.45	.4	38.02	.8	
3	124.64	125.06	.42	125.13	.45	
4	121.03	121.51	.4	122.09	.9	
5	81.93	83.48	1.9	82.74	1.0	
			Av. .74		Av. .84	.1 per cent.

This table shows that the average error in the estimation of wound surfaces varies with the gravimetric and planimetric methods by only 0.1 per cent. of 1 per cent., which is, for all practical purposes, negligible. These results were checked by two different observers working independently. It is worthy of note that the slight intrinsic error in the planimeter has not been taken into account in making these computations.

As simplicity and accuracy are always at a premium in methods that should be generally employed, their wider application will be largely commensurate with the development of an inexpensive, simple technic to determine and record the rate of healing. Carrel (1910, 1916) reports a geometric curve of cicatrization of wounds, while du Noüy (1916) gives an algebraic expression to this curve. If such quantitative studies could be more universally employed in general and hospital practice, soon an amount of data would accumulate sufficient to reduce the element of speculation in determining the action of antiseptics and in estimating the value of different methods of employing them. Much light would be thrown on such problems as the rate of healing, the influence of contraction on the healing process, and the value of different methods of skin grafting. Moreover, these results would be more generally available to the profession as a whole.

The effort in this paper has been to suggest a simple clinical method

of estimating with more or less mathematical accuracy the area of wound surfaces which might be utilized in the study of the rate of healing, the effect of antiseptics and of different surgical procedures upon wounds in facilitating the healing process. Careful studies have been made, as the above records show, of the various factors of error that can enter into the application of the method. In each case the cause of the maximum possible error has been recorded.

SUMMARY

It would appear, then, that the gravimetric method might be recommended for the following reasons:

1. The gravimetric method of determining the surface area of wounds consists of the following simple steps. The usual tracing of the exact pattern of the wound is taken by covering it with a transparent flexible sheet. This pattern is then transferred by means of tracing paper to a sheet of ordinary, accurately cut, bond paper, the weight of which per square centimetre is known. By weighing the cut-out pattern on an ordinary chemical balance and dividing the result by the constant, the exact area of the wound is obtained in square centimetres.

2. The method requires only apparatus which is ordinarily found in hospitals, laboratories, and druggist's. It is simple and requires ordinary skill and care to obtain accurate results.

3. The maximum errors of the gravimetric method are so small that they are, for practical purposes, negligible. They are less than the intrinsic error due either to tracing the wound surface on protective or to retracing this pattern on bond paper. In practice it is as accurate as the planimetric method.

To those interested in following wound healing, infection, antiseptics, and similar problems where a simple and yet accurate means of estimating wound areas is necessary, the gravimetric method offers many advantages over the planimetric method previously employed.

NOTE.—¹Through the courtesy of Professor Tracy, the intrinsic error of this instrument was determined as follows: "In tracing around a three-inch square clockwise and counterclockwise and taking the average, an area of 9.00125 inches was obtained. The pointer of the planimeter was guided along the sides of the square by means of a straight-edge rule. This, of course, eliminated the usual error due to free-hand tracing."

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ACUTE HÆMATOGENOUS OSTEOMYELITIS *

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IN acute hæmatogenous osteomyelitis in children primary operation with removal of only sufficient cortex to allow adequate drainage followed by thorough post-operative Dakinization, will frequently preserve the remaining cortex often seemingly dead. Moreover, deformity may be prevented and the period of disability shortened. Care must be taken to avoid injury of the blood supply by unnecessary curettage and packing. Our animal experiments in chemically produced osteomyelitis have suggested the possibility that any necrotic bone, if sterile, will eventually be utilized as a framework for new bone production. The late war has made the problems of chronic and traumatic osteomyelitis prominent. Little, however, has been written of the acute hæmatogenous variety prevalent in children.

Bone infections among children differ from those in adults, as the epiphysis is not yet united to the diaphysis and, therefore, the problems of therapy necessarily differ. The infection is believed by many to start in the metaphysis near the epiphysis, and then may spread either throughout the medullary cavity or Haversian canals to beneath the periosteum. It may extend to the neighboring joint by being diverted by the epiphysis through the cortex, where it travels under the capsule, or it may penetrate the epiphysis and reach the joint by this channel.

Lexer has well demonstrated the circulation of the long bones in children with radiograms by injecting the arteries with substances resistant to the X-ray (Fig. 1). His work shows very clearly that with the exception of the circumferential lamellæ, the diaphysis is almost entirely supplied through the nutrient artery, while the epiphysis and neighboring portion of the metaphysis receive an abundant blood supply from the numerous metaphyseal arteries. It is in the relatively avascular zone between the diaphysis and metaphysis (Fig. 1, c) that infection probably starts, and it is along this zone that separation frequently takes place when a sequestrum develops. It is interesting to note that the main nutrient artery entering the shaft courses away from the growing epiphysis which is most frequently involved in osteomyelitis.

In 1919 I attempted to reproduce osteomyelitis in dogs before the students of the third-year course in regional surgery at Columbia. At the suggestion of Dr. William Clarke, of the Laboratory of Surgical

* Read before the New York Surgical Society, March 23, 1921.

Research, through a drill hole in the cortex of the medullary canal of the humerus, croton oil was introduced in glass capillary tube containers having their ends sealed with agar-agar. The hole in the cortex was then plugged with bone wax, and the soft parts and the skin were sutured. By this procedure, repair, following the operative trauma, was allowed to progress before the croton oil was liberated from the capillary tube, probably by the solvent action of the cells and body fluids upon the agar-

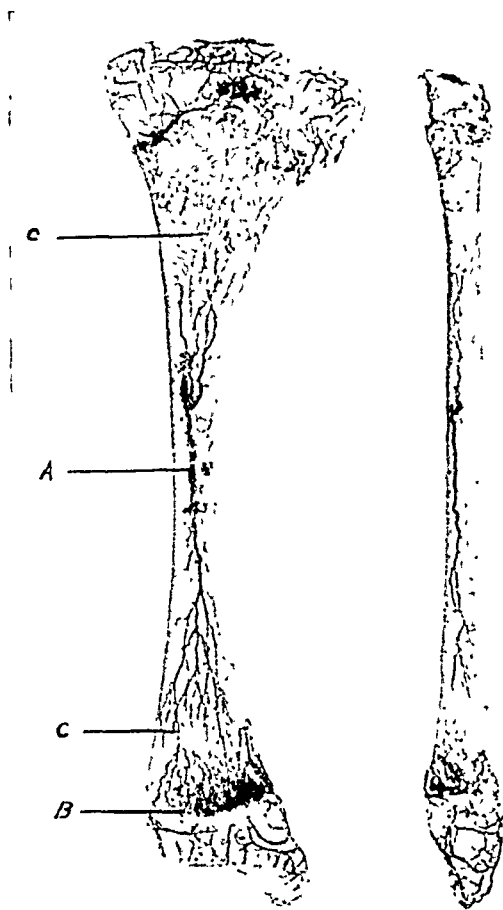


FIG. 1.—Circulation of infant's tibia and fibula. (After Lexer.) A, nutrient artery; B, metaphyseal and capsular arteries; C, relative avascular zone where sequestrum separation usually occurs.

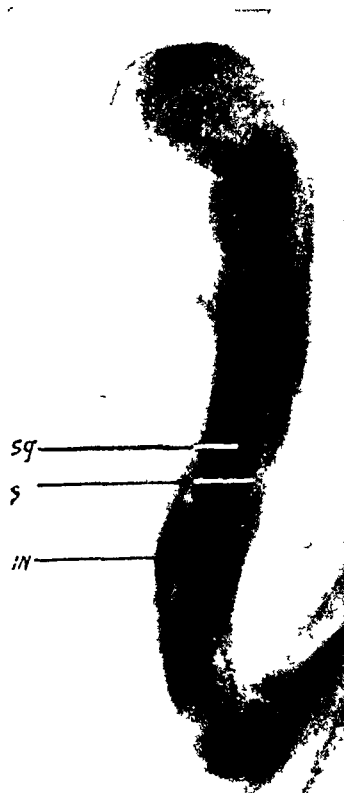


FIG. 2 (Path. No. 5665).—Operation, October 10, 1919. Procedure: Capillary tube containing croton oil inserted in medullary canal. Result: Killed November 3, 1919. Sq, sequestrum; In, involucrum; S, separation zone.

agar. As croton oil causes marked necrosis of the surrounding bone, we were able to produce a chemical osteomyelitis. A sequestrum often 5 to 10 cm. in length and including the entire circumference of the shaft frequently occurred. This sequestrum was separated from a newly formed involucrum by a zone of débris and leucocytes; therefore, all the factors of an acute osteomyelitis were present with the exception probably of bacteria and their by-products. Sections show the sequestrum with an involucrum surrounding (Figs. 2 to 7) but separated from it by a zone of pus. The cortical bone of sequestrum shows absence of nuclei and

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throughout its cancellous portion there is a marked infiltration of leucocytes. The involucrum consists of newly formed subperiosteal bone.

In the prolonged animal experiments radiographic studies show the gradual disappearance of the sequestrum (Figs. 8 to 10), so that at the end of two months it was impossible to detect its former outlines by X-ray. Microscopical sections (Figs. 11 and 12) taken at this time show the disappearance of the zone of separation, and the former sequestrum is now united to the living bone by blood-vessels entering the Haversian



FIG. 3 (Path. No. 5665).—Photograph of cross section. Massive sequestrum extending almost the entire length of shaft. *Sg*, sequestrum; *In*, involucrum; *S*, separation zone.

canals. The process is similar to that found in any bone transplant; gradual absorption and deposition of new bone occurring throughout the Haversian canals until all the dead bone has been replaced.

I have emphasized these facts because I believe they have a definite influence on human surgery. I shall show in the study of clinical cases that in children bone tissues that are apparently dead can be saved to advantage.

During the last five years we have had eleven cases of acute osteomyelitis in children on Doctor Pool's service at the New York Hospital. It has been possible to follow these cases and to observe the results of

treatment. Trauma was the most prominent etiological factor in our series. Six or 60 per cent. received injuries varying from ten hours to two weeks before the onset of the acute process. That trauma and the presence of bacteria in the blood-stream can cause osteomyelitis in animals has been demonstrated by Lexer and others. We have produced it in

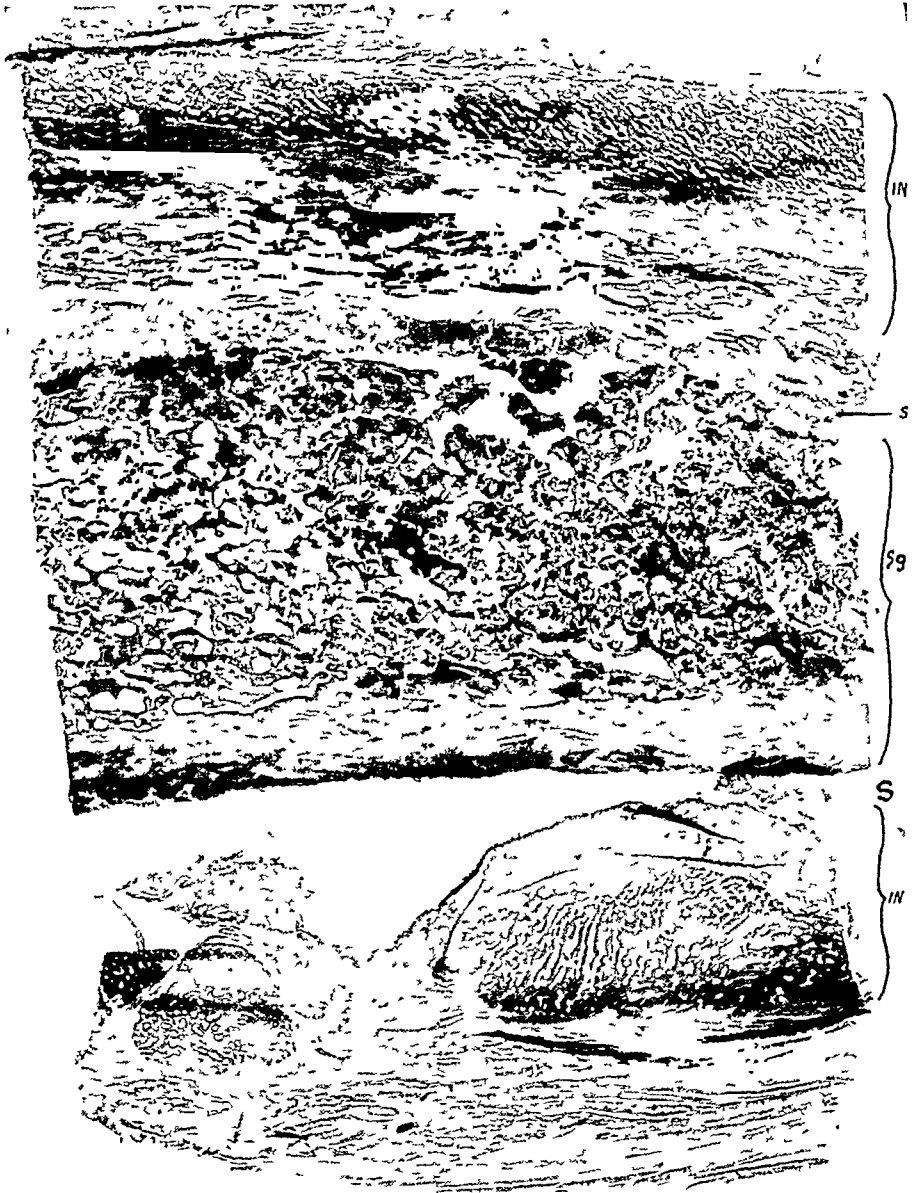


FIG 4 (Path No 5665) —Microscopic section. In the lower zone of separation necrotic debris disappeared during decalcification. *Sq*, sequestrum, *In*, involucrum, *S*, separation zone.

rabbits in the Surgical Research Laboratory by traumatizing the leg without breaking the skin, and injecting into the veins of the ear a strain of staphylococcus from a case of human osteomyelitis, which had subsequently been transmitted through rabbits. On sectioning the femur, which had been fractured by the force of the blow, there was a marked

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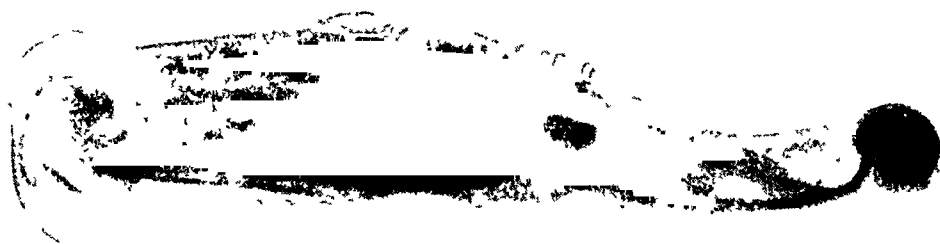


FIG. 6 (Path. No. 6692).—X-ray November 17, 1920. Marked subperiosteal bone proliferation with sequestrum, but small zone of separation.

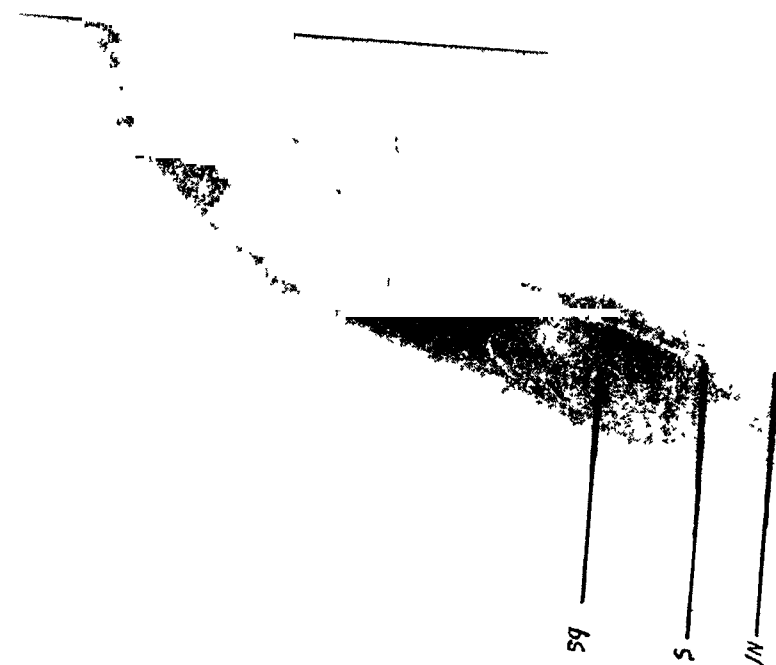


FIG. 5 (Path. No. 6602).—Operation September 21, 1920. Procedure: Capillary tube containing croton oil inserted in medullary canal. X-ray, October 15, 1920, shows large sequestrum in upper half of humerus. Sq, sequestrum; In, involucrum, S, separate zone.

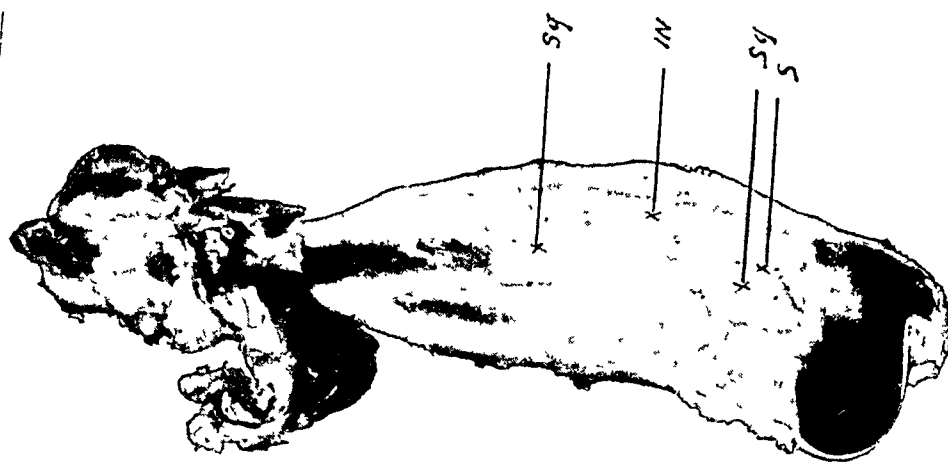


FIG. 7.—Photograph of cross section of No. 6692. Massive sequestrum with thick involucrum and zone of separation. Sq, sequestrum; In, involucrum; S, separation zone.

exudation of pus-cells at the epiphysis and in the medullary canal. The short period of ten hours, between the time of the injury and the apparent onset of the infection in children, has suggested to me that the disease may be due to bacterial emboli locating in the traumatized small vessels near the termination of the nutrient artery on the diaphyseal side of the

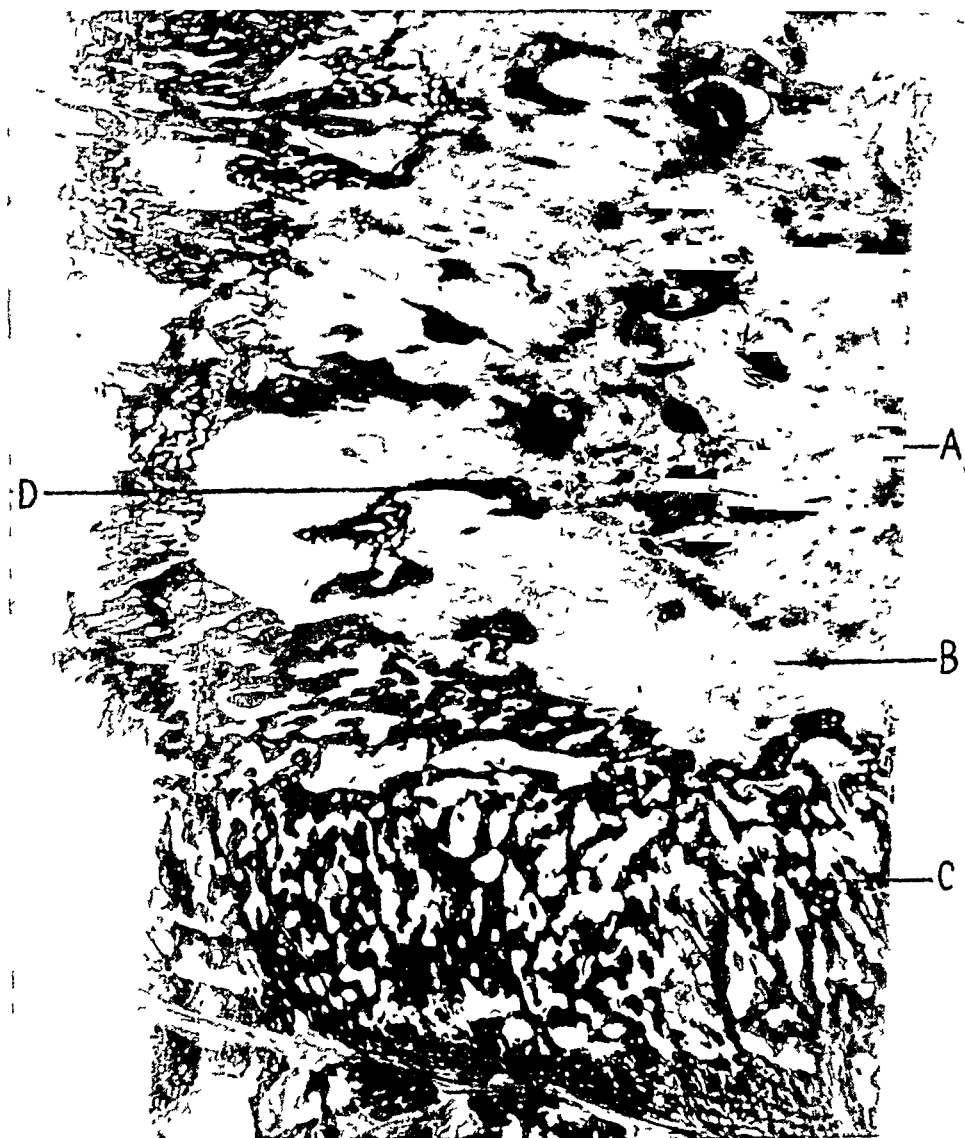


FIG 7A (Path 6692) —Lower power view of terminal portion of sequestrum with surrounding involucrum A, sequestrum, B, granulation tissue, C, involucrum, D, terminal spicule of sequestrum shown under high power in Fig. 7B

epiphysis (Fig. 1, c). Three cases developed without any history obtainable of previous injury or infection. A recent tonsillitis might be assumed to be the etiological factor in one case.

The tibia was involved five times, four in the upper portion of the shaft and once in the lower. The femur was involved four times in the region of the lower epiphysis. The ulna once at the epiphysis. The neighboring joints were definitely infected in four cases. Metastatic

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joint involvements occurred in one case where the hip on the opposite side and the elbow on the same side were severely infected. One case of double suppurative parotitis developed. Three patients developed metastatic osteomyelitis in long bones in addition to the primary focus. All the patients showed signs of severe infection, high temperature and



FIG. 7B (Path. 6692).—Terminal portion of sequestrum showing new bone formation about it, and gradual reorganization. A, Dead bone, cell spaces are empty, showing no nuclear stain; B, newly formed bone surrounding and incorporating dead bone.

pulse-rate, prostration, and all but one case had a high leucocytosis varying from 20,000 to 44,000.

No amputations were done in any of this series.

There was swelling and œdema of the soft parts in ten cases. Bone tenderness on pressure was noted in nine cases and was absent in two cases. Swelling about the neighboring joint was noted in six cases, with limitation of motion in four.

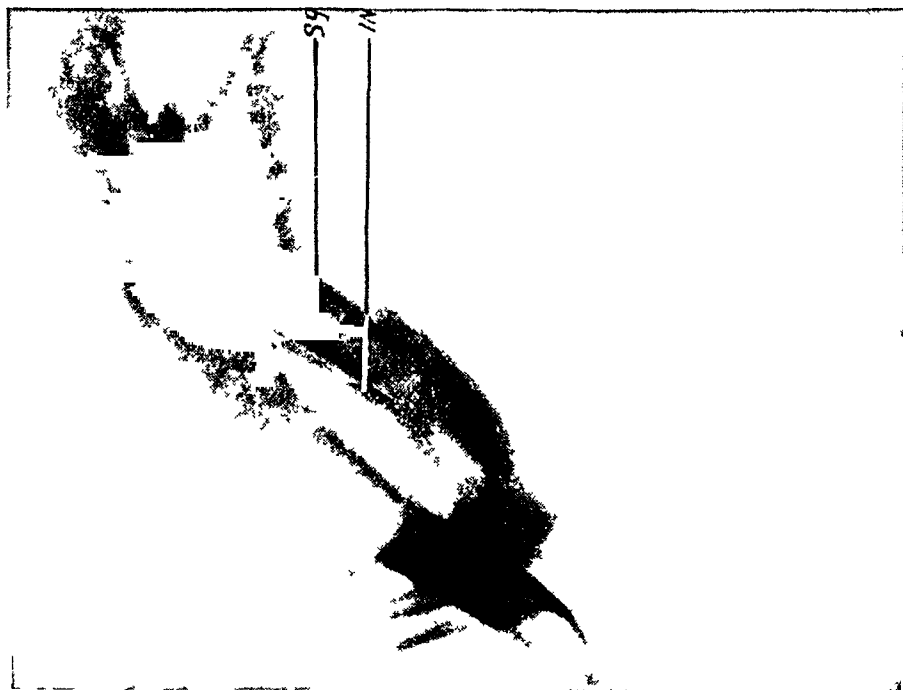


FIG. 8 (Path. No. 5942) —Operation October 10, 1919. X-ray No. 10, 1919. Large sequesterum with well marked involucre and separation zone. *In*, involucre, *Sg*, sequesterum.

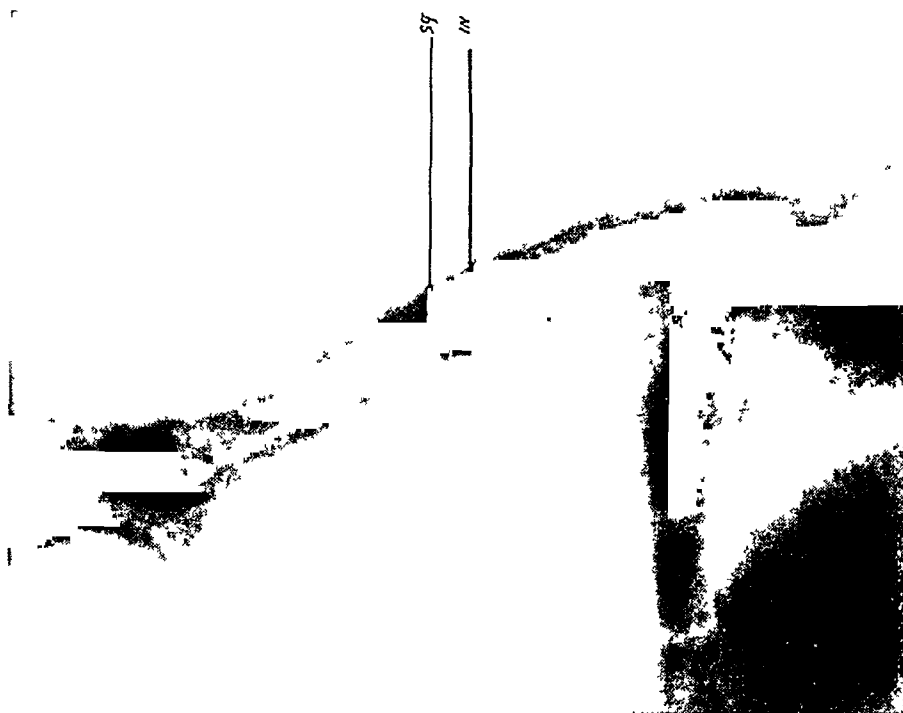


FIG. 9 (Path. No. 5942) —X-ray December 1, 1919. Sequesterum and involucre, but less marked than previous. *In*, involucre, *Sg*, sequesterum.



FIG. 10 (Path. No. 5942).—X-ray January 15, 1920. No involucrum or sequestrum seen.

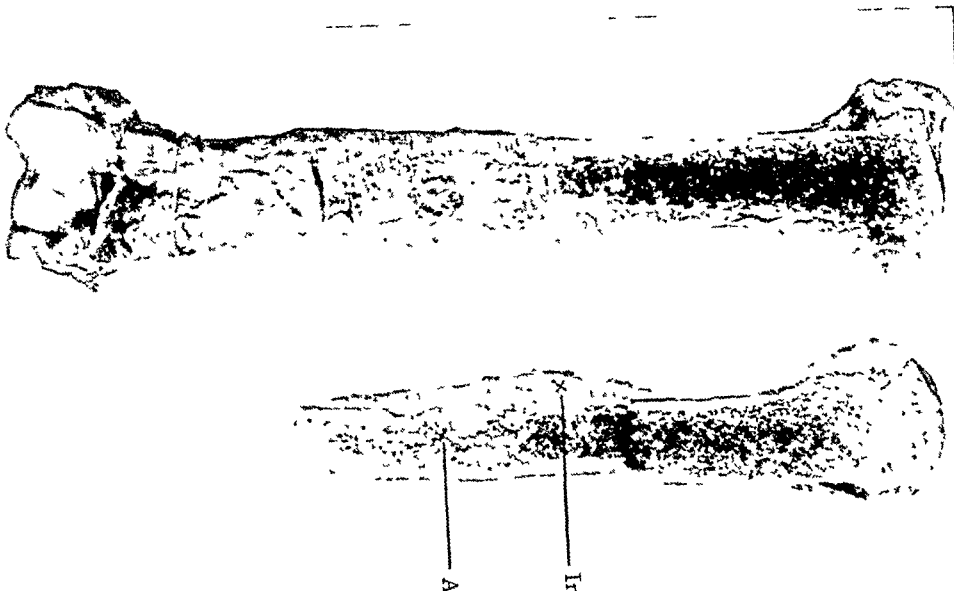


FIG. 11 (Path. No. 5942).—Killed January 24, 1920. Photograph of cut section. In, subperiosteal bone proliferation; A, probable remnants of old sequestrum, but no separation zone.

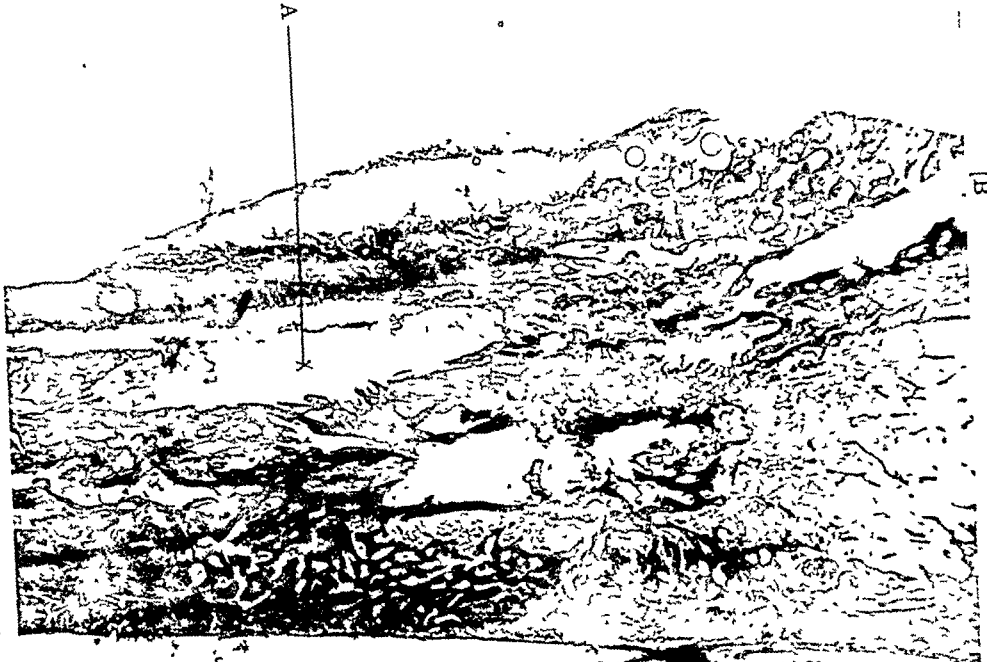


FIG. 12.—Microscopic section (Path. 5942). Subperiosteal bone proliferation. No zone of separation. A, spaces in which capillary tube lay. B, artifact occurring during decalcification.

There was one death, a boy of seventeen years, with osteomyelitis of the femur, who died twenty-four hours after admission from sepsis and cardiac failure. He had a low leucocyte and high differential count.

Follow-up.—Two cases have been lost track of after having been followed for about two years. One of these at that time had a small persisting sinus, the other was well.

The remaining cases have been followed from one to five years and are well. Two cases with joint involvement where the joint was drained now have ankylosis, one a knee- and the other a hip-joint.

The treatment of acute osteomyelitis in children may properly be divided into the treatment of the acute, and secondly, treatment at the subacute stage. Primary indication for operation at the onset is the relief of pus under pressure, and as such, it should be treated with the same surgical principles as pus collections elsewhere in the body; that is, by adequate drainage, with the least possible trauma and with careful attention to the blood supply. If one considers that frequently periosteum with its blood supply has been stripped from the shaft by the exudation of pus and that the only remaining blood supply to the shaft is through the nutrient artery, one realizes the danger to the entire shaft from too active treatment by curettage or packing.

It is true that in the region of the metaphysis, the bony septa somewhat resembles the septa of the mastoid, and that, therefore, in this region it may be necessary to break up the compartments of the abscess. Care even here should be taken not to traumatize any more than possible.

Simmons, of the Massachusetts General Hospital, has suggested making numerous burr holes through the cortex into the medullary canal as the preliminary drainage. This undoubtedly suffices in certain cases. It is difficult to determine the extent of the process by this method, and with post-operative Carrel-Dakin treatment it is probably more conservative to remove more of the cortex in order to obtain adequate exposure and drainage.

The frequent occurrence of metastatic abscess in the region of the popliteal space, when the lower epiphysis of the femur or upper epiphysis of the tibia is infected, has convinced me that a primary dependent drainage through the popliteal space is in general advisable.

Constant, careful post-operative observation of these cases is necessary, as there are frequent secondary metastatic abscesses in the soft parts. The eventual cure of the patient is due to the careful treatment of the interne performing the Carrel-Dakin technic.

The joint infections frequently showing the presence of staphylococcus aureus are usually amenable to aspiration and irrigation. In our four cases where there was either primary or immediate joint involvement, two cleared up under irrigation and two joints had to be drained. I feel certain that in one of our early cases where the knee-joint was drained it would have been better surgery if aspiration had been attempted.

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In cases where septicæmia and bacteræmia are present, it is necessary to attempt to keep up the nutrition of the patient. In addition to transfusion we have found most advantageous the repeated intravenous injection of commercial peptone as advised by Nolf, of Liège. In one child with streptococcus hæmolyticus blood infection, at Doctor Pool's suggestion, we used this method, with an immediate drop in temperature, consequent improvement in the child's general condition, and within ten days the culture was sterile.

Subacute Stage.—Before the days of wound sterilization the course of a case could be fairly definitely prophesied. At the primary operation, the shaft was opened wide, frequently curetted and packed. Following this, sequestration occurred, frequently involving almost the entire shaft. As advised by Nichols, of Boston, the sequestrum was usually removed at a time when the involucrum was strong enough to maintain the shape of the limb, and yet at such a stage when the involucrum could be inverted, obliterating, as far as possible, the "dead space."

With the introduction of the Carrel-Dakin technic up to date clinically we have had results which correspond to a certain degree with results found in our experimental work. Cases No. IX and No. X of this series show marked regeneration of bone which by either X-ray or gross examination appeared necrotic.

On account of limited space brief summaries of only three illustrative cases will be given.

CASE I.—Girl of eight years of age, admitted May 5, 1915, with history of having fallen and injured her left knee four days previous. She complained of severe pain when she attempted to walk. Ten hours after injury the knee was considerably swollen and the child cried with pain on any motion. Examination revealed a knee-joint markedly red, swollen and exquisitely tender. Active and passive motion practically nil. Some swelling in the popliteal space. The knee-joint was at first operation drained and a quantity of pus obtained. Later she developed an osteomyelitis of the lower end of the femur and several operations were done, removing the necrotic bone and draining the abscesses in the soft parts. Following the fourth operation she received a fracture at the epiphysial line and marked displacement (Figs. 13 and 14). During this time she had been extremely ill, with a very high temperature, and her recovery at one time was despaired of. On leaving the hospital she had a shortening of two and one-half inches, fixation of the knee-joint and persistent sinus. At the present time she still has a shortening of two and one-half inches, but otherwise is perfectly well, is able to run, dance, and has not had a sinus for over three years.

Comment.—This patient, with a marked deformity and necrosis of the shaft, attained a very satisfactory functional result; new bone proliferating in such a manner as to change the lines of force and give her a straight leg.



FIG. 14.—Clinical case No. 1, June 5, 1916. Shows reformation of bone. No sinus.

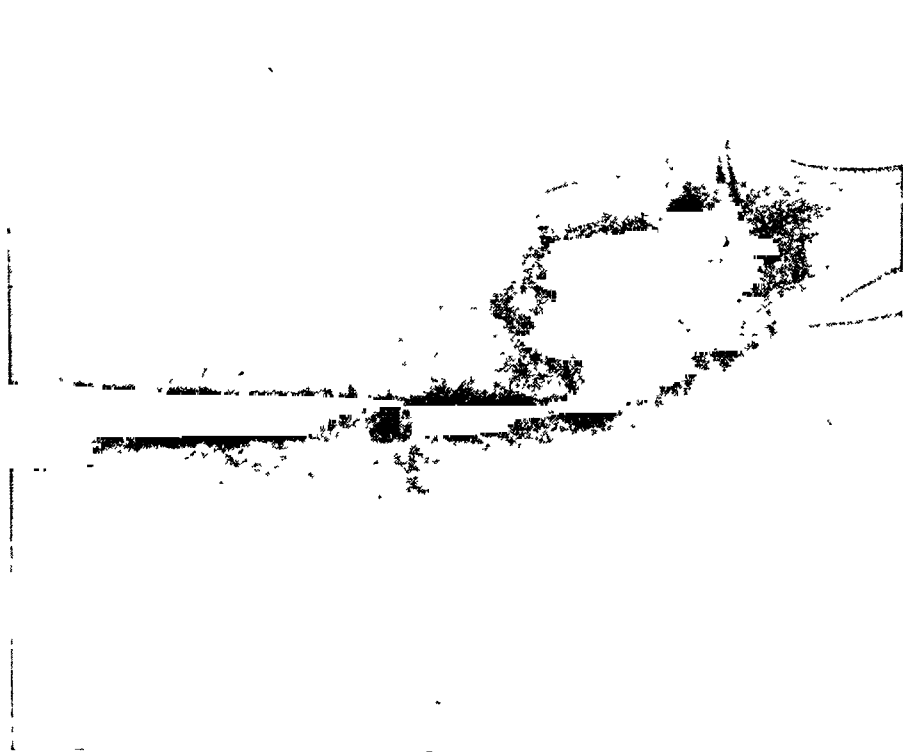


FIG. 13.—Clinical case No. 1 (see case history). Marked destruction of shaft with the fracture at the epiphysal line and displacement, July 12, 1915.

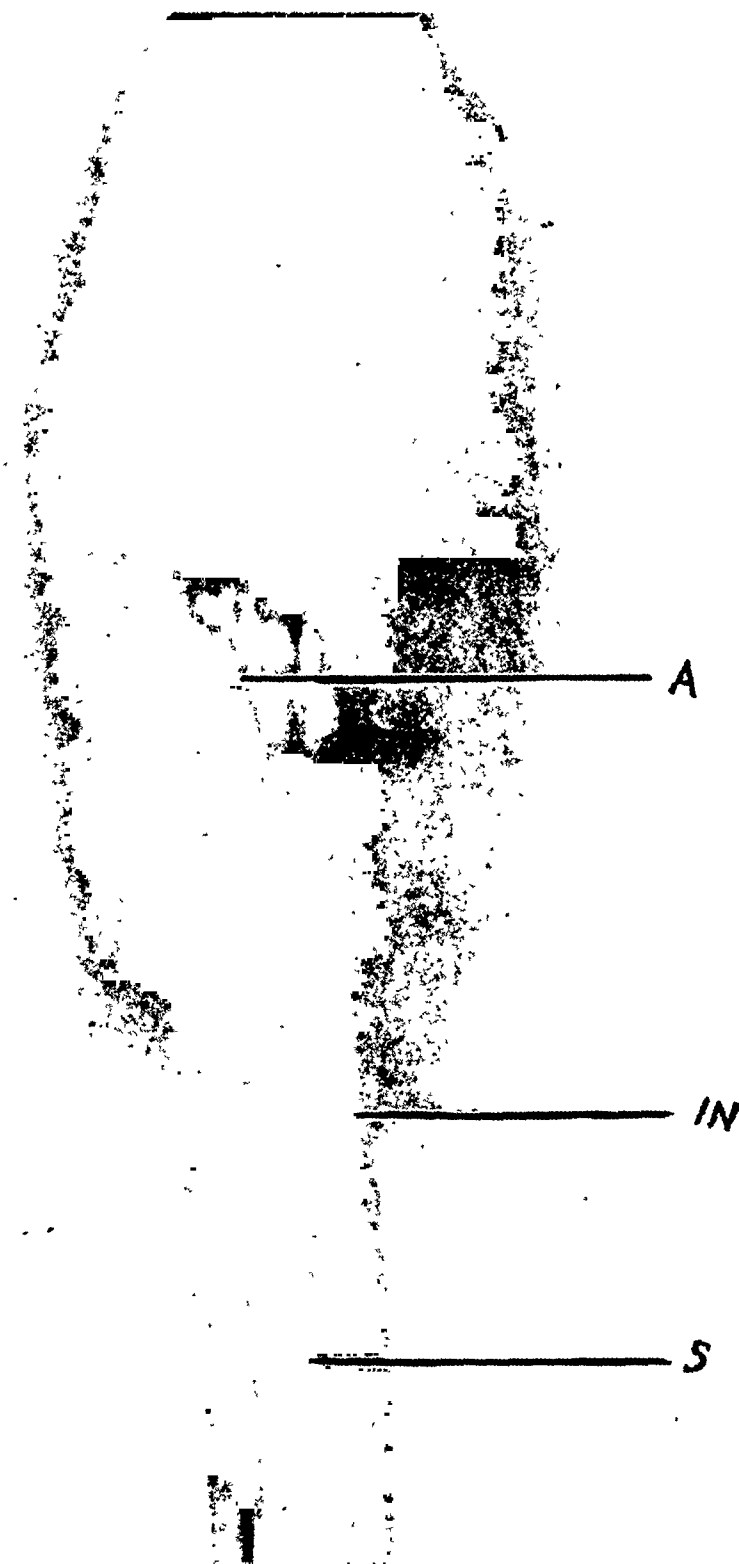


FIG. 15.—Clinical case No. 9. X-ray July 30, 1919. Operation June 22, 1919. Removal two inches of anterior surface upper third of tibia. *A*, area of bone removed at primary operation; *In*, involucrum; *S*, separation zone.

In Case IX (Figs. 15 to 18), a girl of five years, who came into the hospital with an acute osteomyelitis involving the upper third of the tibia, drainage was established by removing the anterior part of the cortex in the upper third. Later X-ray showed a marked rarefaction and apparent sequestrum formation in the lower third. As her temperature was approaching normal, and her condition



FIG 16 —Clinical case No 9 Operation June 22, 1919. X-ray, August 22, 1919. S, former separation zone. Marked subperiosteal proliferation. No operative procedure has been performed on this area.

quite satisfactory, it was considered advisable to delay operation upon the lower third. Later X-ray showed subperiosteal bone proliferation around this zone of separation, and an X-ray one year later showed a relatively normal appearing shaft. At the present time she is well, without any sinus, and apparently the process is cured.

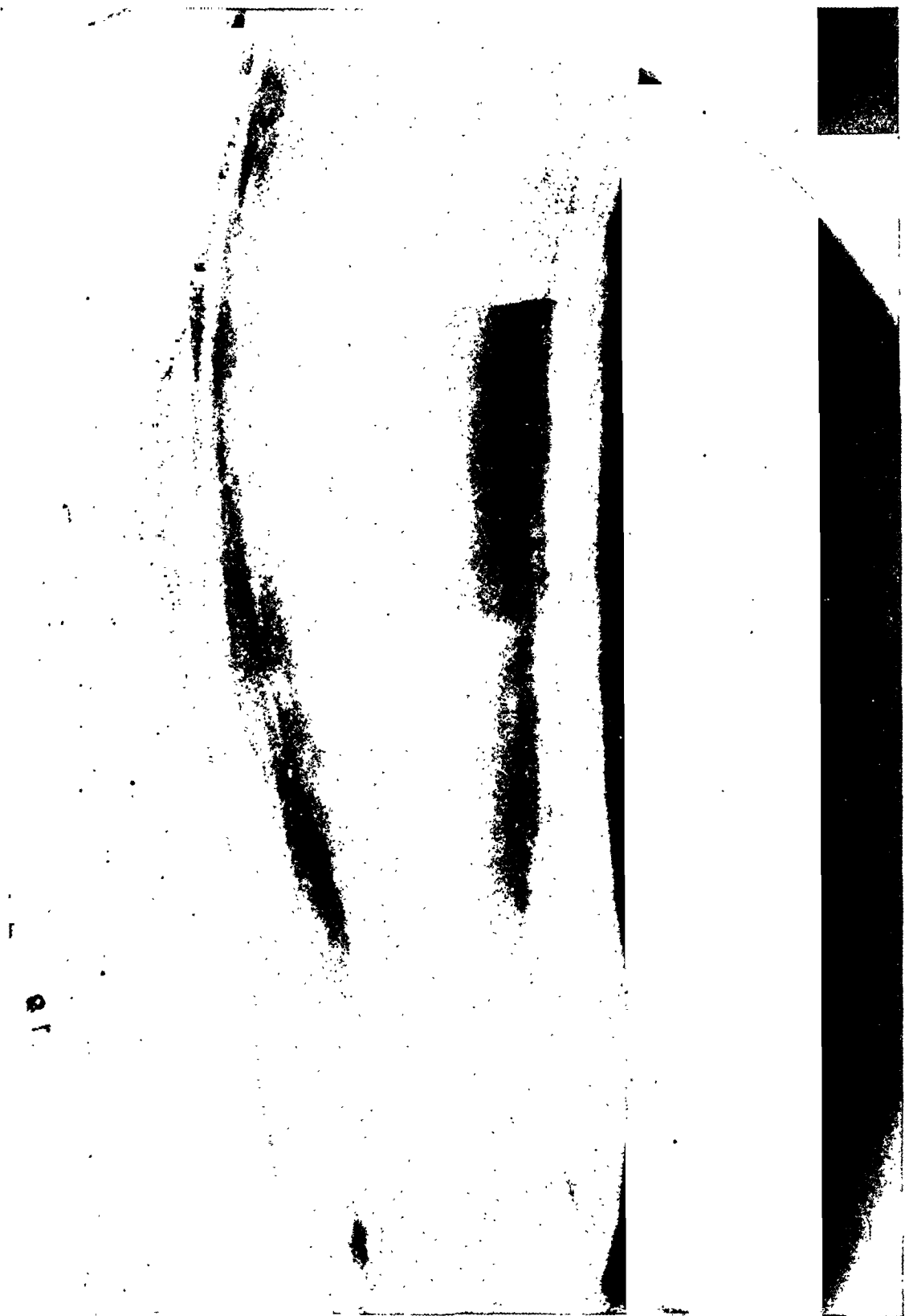


FIG. 17.—Clinical case No. 9. Operation June 22, 1919. X-ray, Oct. 27, 1919, shows bone proliferation. No sign of sequestrum.

Comment.—Primary radiographic studies of this patient showed the appearance of rarefaction and sequestration in the lower third of the tibia. This completely disappeared without any operative interference.

Case X (Figs. 19 to 22), a boy seven years old, who elsewhere had been insufficiently drained for an acute osteomyelitis of the tibia,

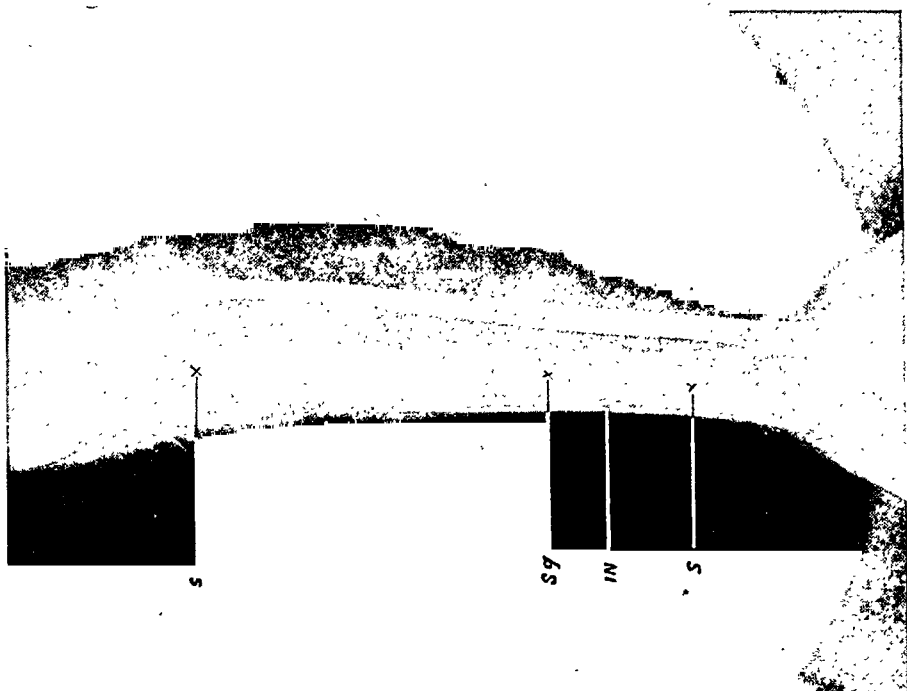


FIG. 19.—Clinical case No. 10. X-ray December 8, 1919, previous to operation. *Sq.* sequestrum; *in*, involucrum; *S*, separation zone.

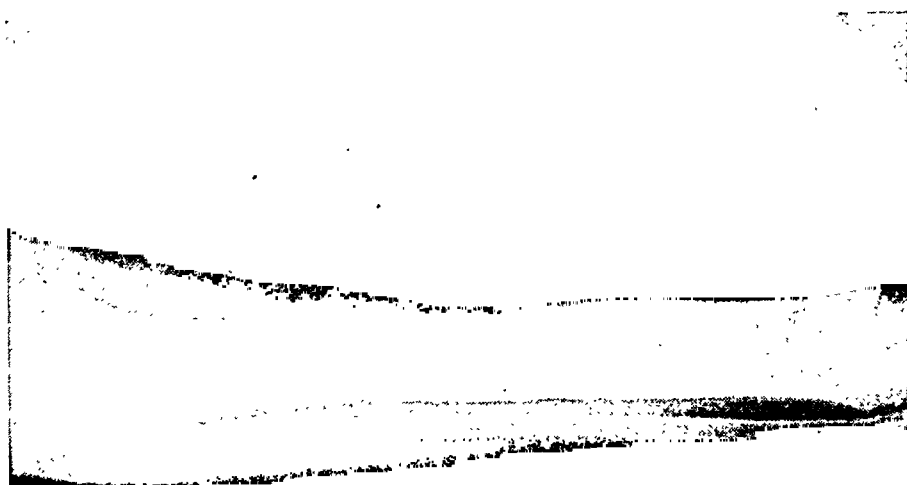


FIG. 18.—Clinical case No. 9. Operation June 22, 1919. X-ray November 24, 1919. No sinus. Patient apparently well.

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came into the hospital extremely ill, with a temperature of 106° , marked leucocytosis and prostration. At the primary operation the entire anterior portion of the cortex of the tibia was removed. There was a fracture of the upper third due to the complete destruction of the bone. Periosteum was separated by pus from the greater part of the shaft. In this case Carrel tubes were inserted posteriorly between the necrotic shaft and the periosteum. The shaft appeared dead. It was not removed because it was thought advisable to maintain this portion of the shaft to prevent deformity. This was



FIG. 20.—Clinical case No. 10. X-ray February 7, 1920. Operation December 9, 1919. Anterior surface of the cortex of the tibia removed. Drainage tube in popliteal space shown. See case history.

the child who had a streptococcus hæmolyticus blood infection and was treated with intravenous injections of peptone. After about five weeks, granulations were seen springing up on the surface of the formerly necrotic shaft. X-rays taken two months after the primary operation showed new bone formation about and apparently incorporating the remnant of the old necrotic shaft. At the present time the patient has a small discharging sinus in the upper third, but the X-rays showed marked new bone proliferation without the sign of any sequestrum.

Comment.—This patient, who was too sick to stand any opera-

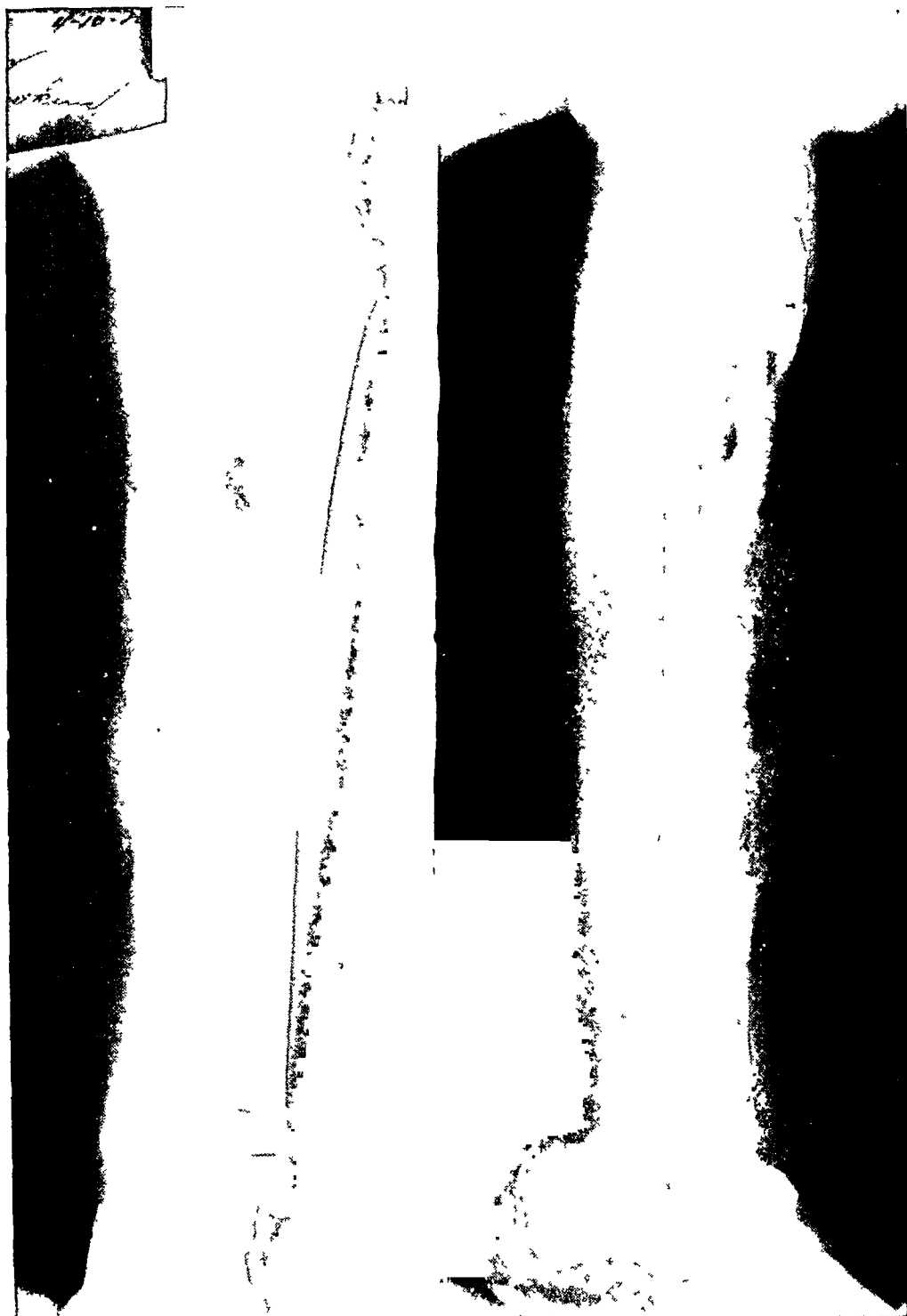


FIG 21.—Clinical case No. 10. X-ray April 10, 1920 New bone proliferation about and incorporating former dead shaft

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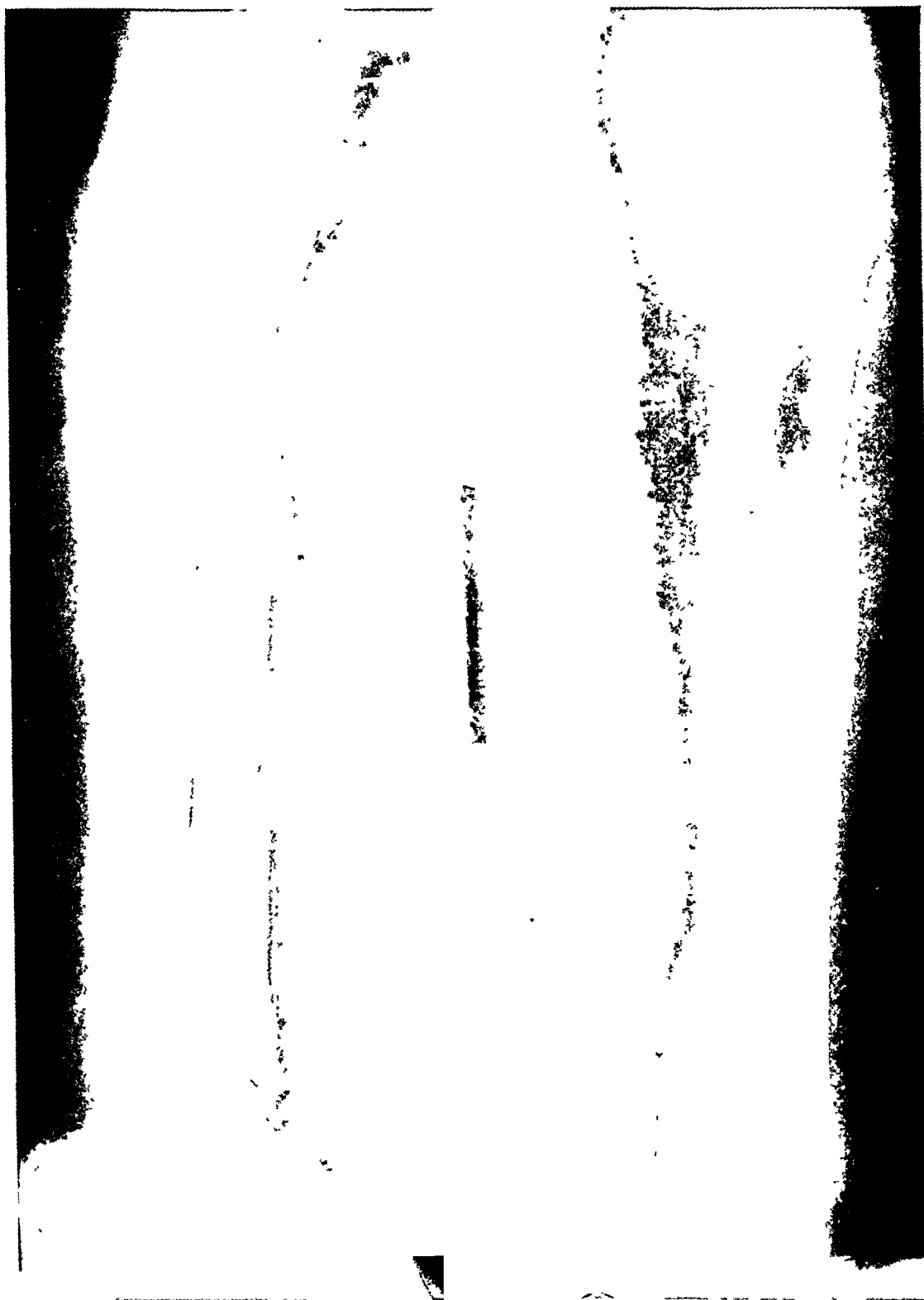


FIG. 22.—Clinical case No. 10. X-ray October 18, 1920. New bone formation. Small sinus in upper third, otherwise healed. Patient walking on leg. Feels well.

tive procedure, had a dead shaft exposed in the wound. After Dakinization, granulation tissue appeared on the former necrotic surface. The bone was later incorporated and the new bone formed about it.

Whether or not in this case the sequestrum was sterilized by the Dakin solution it is difficult to state, but it appears as if it were acting very much as the chemical sequestrum produced by croton oil injections in the experimental laboratory.

Finally, because the whole problem is unsolved concerning the changes which take place in bones, seemingly dead, in the process of repair, this is not a consideration of biological bone changes. These statements are observations of clinical facts, conclusions upon operative findings, and subsequent results of Dakin treatment.

Therefore, from the experience obtained by these cases and from the many animal experiments, I am convinced that in the future in the treatment of children, we can be more conservative, as follows:

First. Adequate drainage should be obtained with as little trauma as possible.

Second. In cases where the patient is clinically progressing favorably, bone, which by X-ray or gross examination appears dead, may frequently be saved to advantage in order to prevent deformity and hasten convalescence.

TREATMENT OF AN OPEN INFECTED WOUND

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EVERY closed wound at some time in its development becomes converted from a closed into an open wound. By this is meant any wound which has a communication, directly or indirectly, with the external surface of the body.

The treatment of a non-infected open wound is the same as that of an infected open wound, after the infecting agency has been overcome. The healing reactions from this time in both types of wounds are somewhat similar, with this important exception; namely, that the amount of destroyed and devitalized tissue in an infected wound which has been aseptized is much greater than in a primary non-infected wound. The most beneficent effect upon the organism, when the suppurating non-open wound becomes a suppurating open wound is that the absorption of toxins which had previously in the closed suppurating wound been most active is now minimized. The active absorption in a progressing closed suppurating wound is due to the fact that, constantly in a wound of this character, the protective barrier, formed by granulation tissue, leucocytes and exudate which are present, is broken down and is interrupted in various places by the more or less rapidly advancing necrosis and liquefaction. Depending upon the rapidity of this liquefaction necrosis and the virulence of the infecting bacteria are the extent and severity of the systemic symptoms which result from the absorption of poison produced in the suppurating area. These poisons, when absorbed, give rise to toxæmia.

If, in the advancing process associated with the development of the wound, there is a further breaking down of the protective barriers, so that the tissue spaces become open, and there is lymphatic and circulatory migration of the bacteria into the lymphatics and the small capillary radicles of the venous system, there then results not only a most marked and severe toxæmia, but a further change in which the infecting bacteria are present in the blood, the condition termed septicæmia. If the bacteria localize in some area foreign to the wound and at some distance from it, they may cause abscesses (metastatic).

The treatment of an open suppurating wound therefore resolves itself into the treatment of the four most active phases. First, the treatment localized to the wound itself; second, the treatment aimed to counteract the toxic effect of bacterial protein absorption; third, the treatment which is directed against bacteria which are circulating freely in the blood, and fourth, treatment of the mesenteric abscesses. While it is not the inten-

tion to consider the treatment of non-infected wounds, yet it may be well to briefly discuss the prevention of infection, *i.e.*, the prophylaxis of wounds already harboring pathogenetic bacteria but as yet showing no signs of infection. In all contused, lacerated, or incised wounds in which infected material is implanted, at the time of their infliction, a certain interval elapses before the infection manifests itself. This varies from eight to twenty-four hours. During this time, if all dirt and foreign material is carefully removed, all devitalized tissue dissected away, and the wound is carefully aseptized, before and after the cleansing, by soaking it in a $3\frac{1}{2}$ per cent. solution of iodine in 50 per cent. alcohol, it may be closed by immediate suture and primary union frequently occur. In badly lacerated scalp wounds and in comminuted fractures of the skull, the entire devitalized area, including the destroyed bone, should be removed by section through healthy surrounding tissues. Should, in this cleansing process, a large area of brain cortex be exposed, it is covered, either by a sliding or a pedunculated flap, whichever the mechanics of the case demand. This method, primary prophylactic cleansing and excision, requires that in every case a sufficient area (at least 1 cm. from the edge of the wound) be resected, so incision may remain beyond any colonies of bacteria which may have been forced into the surrounding tissues, at the time infliction of the wound may have infiltrated in these tissues during the interval between infliction and treatment.

Should the prophylactic tissue resection and treatment have failed, or should the wound be already infected at the first examination, it should then be treated as an infected open wound.

This treatment, as has previously been said, is directed first to the treatment of the wound itself, which may be regarded as the local treatment. Second, the treatment of the toxæmia, of the septicæmia and of the pyæmia. These all may be grouped under general treatment and will be so considered.

The local treatment is carried out through the following processes: I. Cleansing the wound. II. Rendering the wound sterile. III. Supporting the wound by (a) rest, (b) increasing the local resistance, (c) increasing the activity of the leucocytes in the granulation tissue wall. IV. Closing the wound by (a) direct suture, (b) by granulation, or (c) by graft.

I. In cleansing the wound all devitalized and necrotic tissue should be excised. The wound should be thoroughly irrigated with a hot antiseptic solution, such as iodine $\frac{1}{2}$ per cent. or any other suitable antiseptic solution. Violence should not be used, gentleness is most essential. It is better to remove adherent tissue with a knife or scissors than to pull, tear, or gouge it away. After the wound has been cleansed, it should be covered with dry dressings. Should it remain infected, it must be rendered sterile.

II. Sterilization of the wound may be brought about by a combination

of the following: (a) The direct destruction of the bacteria by the application of antiseptic solutions to the wound. (b) The lowering of the bacterial resistance, either by the reduction of the suitable nutritive media for the bacteria, or the application of cold to the infected area. (c) By engrafting on the wound a growth of bacteria which, while harmless to the host are inimical to the invading pathogenic bacteria.

Bacterial destruction is also hastened by

III. Supporting the wound by (a) local rest, if the wound is on a movable tissue, splints, casts, or supporting bandages are applied, so as to make the part immobile; (b) rendering the local tissue cells more resistant to the bacterial toxins, and at the same time (c) stimulating leucocytic activity in the protective granulation wall erected around the infected area, synchronously increasing in thickness the granulation wall; (d) local segregation of toxins should also be attempted; (e) reversal of the lymph flow (so that the wound weeps fluid) may also be promoted, either when the infecting organisms are of a low or after a leucocytic wall has formed, or in combination with antiseptics in cases of very severe and dangerous infections. In fact, in such infections this type of exosmosis might be tried in combination with a very strong antiseptic. The reversal of the lymph flow may be induced by Bier's hyperæmia bandage, by suction, and by the continuous application to the infected area of hypertonic solutions of different salts.

Schiassi has long been emphasizing the advantage of treating war wounds by inducing an intense flow of fluids outward, by exosmosis from the depths of the wound. He defines the process as an "exhumoral expulsive cellular antisepsis" supplemented by an intense plasmatic and histologic defense and regeneration. The solution he uses for this purpose is a mixture of 8 gm. sodium chloride, 1.5 gm. glucose, and 1000 c.c. water. For stronger action he adds to the above 2 gm. sodium citrate and 0.5 gm. sodium hydrate.

This fluid disintegrates dead tissues and draws fluid out of the tissues as if by suction. This exosmosis is further promoted by keeping the part in a hot bath for hours at a time.

In this same relation Sir Almroth Wright (*Lancet*, 1917, 1, 930) recommends a hypertonic solution of salt as a means of breaking down the leucocytes. This liberates tripsin which rapidly digests the dead tissue from the living. To carry off the infection a reinforced solution (salt solution normal, and 25 per cent. zinc sulphate) is used. The removal of the discharges is, according to Wright, a very important procedure, and according to him is the especial merit of the Carrel-Dakin treatment. All the antiseptics of the chlorine group are active lymphogogues. This lymph discharge decreases as the granulation tissue increases.

IV. After the wound has been rendered sterile, it is closed, either by direct suture or by granulation. The sterility of the wound is determined by direct microscopical examination of the discharge taken from different

areas of the suppurating surface. Ordinary platinum loops are used to smear the discharge from the suppurating surface on the slide (microscopic). When not more than one organism per five fields is present the wound may be closed by direct suture.

During this time the local treatment should not absorb our entire attention, but we should consider carefully the general condition of the patient and institute appropriate measures for his support and relief. These measures will be discussed after the local treatment has been covered.

Local Treatment of an Open Wound.—Since we have already described the method of wound cleansing, we shall now discuss the sterilization of the infected focus by the direct destruction of bacteria with antiseptic media.

Bacteria, because of their capsule formation, are greatly resistant to antiseptic media. This capsule is the result of the accommodation of the bacteria to the animal body. It is most marked in the bacteria resident in the predilection places for chronic inflammation, such as the lungs and middle ear (Sauerbeck). The ideal disinfectant is one which destroys the bacteria, but does not destroy the animal cells, and the ultra-ideal would be a disinfectant which has a specific and selective action on the bacteria which are the cause of the infection. As yet, principally because of the resistant bacterial capsule formation, no such antiseptic has been found.

The rapidity with which a wound heals depends to a considerable degree upon the activity of the leucocytes. They destroy the bacteria and remove the débris, both dead bacteria and disintegrated tissue cells. Most disinfectants have a deleterious action on the leucocytes and hinder their mobility and phagocytosis. However, there are some antiseptics, as mercury and the hypochlorites, according to Dakin, quoting from Perry Morgan, which have little effect on phagocytosis. Activity of leucocytes obtained from wounds recently treated with hypochlorites was regularly noted. Nevertheless, as Dakin and Dunham observe, the death of a certain number of cells is of relatively slight importance if the offensive organisms are at the same time materially diminished in numbers or in offensive capacity.

Yet it should be remembered when formulating antiseptic media that such media must be as slightly injurious as is possible to the tissue-cells, while at the same time they should exert the ultimate degree of destruction against the invading bacteria. In this respect it is well to recall the point which Ross brings forth; namely, that the "cell cannot control the diffusion of substance into itself, nor can it choose from its surroundings any one substance and leave another." Therefore, antiseptic substances which are destructive to animal cells should be used with great caution.

III. Measures for Supporting the Wound.—These are to be classified as (a) local rest, (b) rendering the local tissue-cells more resistant to bacterial toxins, (c) increasing the number and stimulating the activity of the leucocytes in the protective granulation tissue wall erected around

the infected area, and at the same time increasing in thickness of this granulation wall with (*d*) local segregation of toxins and (*e*) reversal of the lymph flow. *A, d, e* have been discussed. (*b*) The rendering of the local cells more resistant to bacterial toxins has as yet but an academic interest. It might seem possible that the injection of autogenous vaccines circumferentially around the infected area, not too far from the edge of the wound, may have an influence in stimulating the resistance of the cells in the infected area provided the vaccines could come into contact with the involved cells; and then if a reversal of the lymph flow with hyperæmia of the part be induced, it is an interesting hypothesis to suppose that the local cells will develop an increased resisting, perhaps destructive power, against the pathogenic invading organisms. Simultaneous with (*b*) an effort should be made to stimulate the regenerative forces and excite the reactive processes necessary for the healing of the wound. These are included under (*c*) (see above).

The increasing of the number of leucocytes in the leucocytic wall and at the same time the stimulating of the amœboid activity of those which are present in the wall may be brought about by local measures, such as heat, hyperæmia (passive) and stimulants, such as balsam. These also increase amœboid activity and growth. The leucocytes in the circulating blood may be increased by giving internally certain stimulants, such as nucleins or nucleates. Diathermie may be of some value, as an aid to increase leucocytic activity and tissue reaction. Atropine will also cause an increase in leucocytic movements (Ross).

Local measures aiming to increase the granulation tissue wall and stimulate cellular reproduction include the use of auxetics. Ross, of Liverpool, was one of the first to recognize the rôle of certain substances stimulating cellular reproduction. These substances when they come into contact with living cells cause cellular growth and reproduction in these cells. In his studies of cancer-cell growth Ross found that broken-down cells and certain derivatives of coal tar caused a marked cellular proliferation. After considerable experimentation he devised compounds which have as their basic action the stimulation of cellular proliferation. The stimulating substances he termed auxetics. Some of them are atropine, quinine, cadaverine and theobromine. For practical purposes he devised both a solution for swabbing and a paste for application. The solution for swabbing consists of sod. chloride, 0.9; sod. cit., 1.0; theobromine, 1 (to saturation); water, 100.0. The paste for application is composed of sod. chloride, 0.9; sod. cit., 1.0; tyrosin or theobromine, 1.0; sod. carb., 1.0; water, 100.0. Cadaverine (pentamethelene diamine) increases the action of the auxetics about five-fold. It is what Ross calls an augmentor.

The increase of the thickness of the granulation wall is induced by (1) the removal of all positive pressure in the suppurating cavity and simultaneously maintaining communication with the external surface.

This causes an increase in size and thickness of the granulations, because granulations are the result of the positive pressure inside the vessels forcing up towards the surface small branches of these vessels. Some claim that the new vessels are formed from the endothelial cells of the smallest vessels, while it is claimed by others that they are formed by the fibroblasts. Therefore, any process which would force with extraordinary rapidity the terminal capillary tufts up onto the surface increases the healing. (2) Granulation tissue is also increased by heat, applied by means of the hot-air cabinet, hot packs, thermophere, sun rays (direct exposure to the sun). These have a positive stimulating action on the granulating surface. (3) Light is wonderfully efficacious in slow healing. It stimulates granulations. The violet rays are very superficial in their action. The X-ray will kill bacteria. Incandescent light probably depends upon its activity in stimulating granulating surfaces upon the hyperæmia which it induces. An accessory essential to the above measures is rest. The rest should be both mental and physical, local and general. In severe infections the patient should rest quietly in bed. If he is restless a sedative should be given. All worry and mental strain should be relieved as much as possible, and sleep should be induced. The inflamed part should be immobilized by splints, casts or supports. Adequate drainage to properly carry away the discharge should be provided. Dressings must be changed as frequently as they are soiled, but the wound should be handled as little as possible. After the suitable local measures have been provided, general measures aiming to increase the general health of the patient are instituted. These will be fully discussed under general treatment.

IV. After the wound has become sterile and is granulating a decision should be reached as to whether it should be allowed to heal by granulations or whether it should be sutured or whether grafts should be used. All superficial granulating wounds heal quicker if pin-point grafts are transferred to their surface. Over the grafts as a protection is placed a perforated, paraffinized, meshed dressing. This is not removed for some days. The wound is freely exposed to the air and to a moderate degree of sunlight. If the wound is a deep one, it is not suited for grafting and the tissues should be brought together by sutures, and the skin should also be closed by suture; various methods of flap formation being used to cover in the denuded surface. If it is impossible to cover in the surface by any method of flap formation, it is necessary to allow the wound to heal by granulation, and at the proper time to apply skin grafts. A further discussion of the healing factors active in wound healing by granulation will be discussed under the recovery stage.

General Treatment.—If during the treatment of an infected area symptoms of toxæmia or sepsis arise, measures should be taken at once to combat or neutralize the poisoning. These measures are: I. The introduction of large quantities of fluid into the system. This fluid may be

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given by mouth, if the patient is conscious and there are no other contraindications, or by enteroclysis, hypodermoclysis, or intravenous in states of great urgency or where a sure and certain result is sought. The most efficacious fluid to introduce into the system as a means of combating infection is, as far as is known at the present time, a combination of sodium carbonate or bicarbonate and glucose.

Sodium carbonate is used in enteroclysis and intravenously, but not in hypodermoclysis, because of its great tendency to produce necrosis of the tissues and sloughing.

Glucose in the blood acts by being first converted into glycuronic acid which unites with organic and inorganic bases circulating in the blood. For instance, skatol and indol are first oxidized and then unite to the glycuronic acid. Sulphuric acid acts in a similar manner. For instance, indol is changed into indoxyl and this in turn into indican.

The oxygen for the above changes is readily furnished from the carbonate which is given with the glucose. Because of the great combining power of the sulphate I am in the habit of strengthening or increasing the action of the glucose and alkali by adding KHSO_4 to the enteroclysis in the proportion of 1 to 500.

It has also been claimed that glucose (Wells) acts as an antigen. This action is greatly increased by the presence of an alkali. This is probably the chief action of the alkali carbonate, when it is combined with glucose in the combating of severe infections. Another reason for using alkalies is that increase of the alkalinity of the blood will increase its bactericidal power (Wells, p. 228).

II. If the infection is very severe and the patient's resistance is being overcome, the most certain and effective means at our command of giving support, until the critical moment has passed, is blood transfusion. I have seen patients, who were otherwise doomed, recover sufficiently by this means to enable them to carry on and develop a resistance to the infecting organisms. Improvement was practically immediate and the recovery stage markedly shortened. The donor should be carefully selected by the method of grouping as advocated by Moss. An attempt may, if time permits, be made to render the donor's blood antitoxic to the infecting organism by injecting into the donor vaccines made from appropriate infecting bacteria, derived from the recipient. In doing this care should be exercised that the donor's blood is not removed in the negative reactive phase; otherwise harm to the recipient will result. Blood transfusion is of value in any stage of sepsis, but especially in the early periods of the fulminating type, when the patient is rapidly losing his resistance and the recovery is problematical.

Further methods of combating the infection and resulting toxæmia are:

III. The introduction into the system, if at all possible, of an antitoxin to the causative bacteria. This is now possible in a few instances, as in epidemic cerebrospinal meningitis, tetanus. In pneumococcic menin-

gitis antipneumococcic serum is active in about 30 per cent. of the cases. Streptococcic meningitis is practically always fatal. To my knowledge no case has ever recovered.

The methods of using or applying the antitoxin are: (1) Local application. (This has been recommended by McGlannan.) (2) Injection into the infected area or the adjacent tissues. (3) Injection into special tissues. (Nerve tissue, as in tetanus.) (4) Injection into the circulation. (5) Injection into the cerebrospinal canal. (Tetanus.) In addition, it is also necessary:

IV. To support the patient until the antitoxin acts, or if no antitoxin is available, until the body has had time to marshal her forces and has produced her own antitoxin. The principal means of doing this are:

1. By increasing the nourishment of the body, with consequent increase in the local resistance.

2. By stimulation of antitoxin formation. If the body reactive forces are sluggish, the injection of vaccines will sometimes incite the antitoxin-producing apparatus to full activity. In operative cases, where infection is feared, an injection of a mixed vaccine prior to, and one immediately after operation, may save a life which otherwise would be sacrificed to the moloch of careless antisepsis.

3. Keeping up the fluids of the body is most important. They are maintained by:

(a) Enteroclysis of sodium carbonate 5 per cent. and glucose 5 per cent.

(b) Hypodermoclysis of sodium bicarbonate 2 per cent. and glucose 2 per cent. or 5 per cent., or of salt solution.

(c) Intravenous injection of sodium carbonate 2 per cent. and glucose 2 per cent. or 5 per cent.

4. By maintaining the blood-pressure. In severe cases of infection the blood-pressure drops; the systolic not so far, but the diastolic drop is very marked. If the diastolic drops below 60 the case is becoming serious, and if the drop is below 50 the case is most serious. Porter claims that a patient whose diastolic blood-pressure remains at 45 or 50 for some time will not recover without external aid. When the pressure drops to 50 the blood accumulates in the abdominal veins and a further reduction of pressure with lessened probability of recovery occurs.

The treatment for this condition as instituted consists of:

A. Gravitation. The feet of the patient are kept 30 cm. higher than the head. The pillow must not be more than 6 cm. high. This position is retained until the diastolic pressure returns to and remains at normal.

B. If the patient's condition is grave, other means may be employed, *i.e.*,

(a) Saline transfusion, if the pressure is below 80 mm.

When the pressure reaches 80 mm. the transfusion

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should be stopped. Five hundred c.c. should be used and ten minutes taken for the injection. If the first transfusion does not bring the blood-pressure up to 80 mm. a second transfusion may be used.

- (b) If after the saline transfusion there is a tendency for the blood-pressure to drop, adrenalin should be used.
- (c) Should hemorrhages be present, the saline would have a tendency to increase them. In such cases Porter recommends the transfusion of blood.
- (d) In cases of superficial reduction in temperature heat should be used. In all cases the diastolic pressure should be read every half hour, and an operation should not be undertaken if the pressure remains below 80 mm. Should operation be undertaken, death is almost certain to result.
- (e) To eliminate the toxic products, such drugs as digitalis, caffeine, acetates, etc., should be exhibited.
- (f) General stimulation should be used and the patient should be exposed to the sun's rays or to electric light baths.

In infection the question frequently arises, how are we to determine whether the organism is overcoming infection, or vice versa—whether the infection is overcoming the organism? The best indicator at our command is the behavior of the white blood-cells. It seems that the percentage of the increase of the polymorphonuclear is an indicator of the severity of the infection, while the relative increase of the polymorphonuclear to the total white is an indicator of the resistance of the organism (Sondern, etc.). The increase of the polymorphonuclear, without a relative increase in the leucocytes, indicates that the organism has not the required resistance and is being overcome, and two proceedings are indicated:

1. Surgical interference, in order to remove the toxic factors, and
2. Improvement of the resisting powers of the organism.

Number one should be considered under special technic. For number two several means are at hand. At the risk of too frequent repetition, it should be emphasized that among the best are those calculated to directly antagonize the toxins of the implanted bacteria. Among these are the different antitoxins and direct antiseptics, as salvarsan, bichloride, etc. (intravenous).

The acidosis may best be counteracted by alkalies as the sodium carbonates or bicarbonates in combination with glucose. Or the resisting power of the organism may be directly stimulated by the direct injection of nucleins, nucleic acid, etc.

The fifth stage of an open infected wound, that is, healing by granulation, is the

V. *Recovery Stage*.—At this time, if healing is progressive, there is:

1. An increase in granulations which may be stimulated by:
 - (a) Heat. It is very essential to the rapid healing of a part that the proper degree of heat be supplied.
 - (b) Moisture. This most essential detail of wound treatment is frequently overlooked. In old sluggish wounds moisture in the form of wet boric acid compress is very beneficial.
 - (c) Auxetics, as kreatin, xanthin, which produce an increased cell proliferation; Ross's paste which consists of salts, theobromine, etc.
 - (d) Irritants, as silver nitrate, balsam, and light rubbing with gauze. This method of interference should not be used if the healing process is proceeding normally, and should be used only if healing is sluggish or greatly retarded.
2. An increased antitoxin formation. This is stimulated by vaccines, as diphtheria, tetanus.
3. An increased resisting power of tissues which is stimulated by:
 - (a) Nourishment, such as: (1) Food. (2) Transfusion, which brings to the diseased area fresh blood-cells and antigen.
 - (b) Rest.
 - (c) Vaccines of the particular type causing the infection.
 - (d) Protection to the part, so that excessive motion, pressure or irritation does not occur.

The granulating surface may be protected by various substances. The latest and best is the paraffin wax of L'Ambri. This is very useful in the treatment of burns. However, the granulating surface must be clean (absence of pus) and dry before the wax is applied.

In this recovery stage the body forces may either be exhausted or else may be equalized by the toxic products of the infected area and healing becomes stationary. This loss of activity is indicated by an excess of necrotic tissue. This necrotic tissue may be removed and healthy granulations exposed by digestion with combination of pepsin, pancreatin, etc., with an antiseptic. It may also be removed by rubbing with gauze or a dull curette.

If the infectious process is too powerful, it may overcome the resisting barrier which the body has erected to its progress, and instead of being progressive the healing is retrogressive and may result in generalized blood involvement, causing septicæmia and pyæmia. If this occurs, the action of the bacteria circulating in the blood may be combated by (a) antitoxins of the same type of bacteria, or (b) antiseptics introduced intravenously, as bichloride as much as $\frac{2}{3}$ gr. in 50 c.c. of distilled or salvarsan water, or quinine as high as 20 gr. or in the form of urea and

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quinine hydrochloride gr. $7\frac{1}{2}$ every third hour, given intramuscular; salvarsan may also be used.

A progressive infection may also cause an increasing acidosis which may be combated by the injection of Na_2CO_3 or NaOH or saline, or by the introduction of oxidizing substances, such as glucose. These injections may be by bowel, by hypodermoclysis (be careful not to use sodium carbonate), or by intravenous.

At this time, when the patient's general resistance is reduced, an increase of the generalized resistance may be brought about by the injection of carbohydrates, sugars, etc., and by nourishing and easily digested food. In all septic states plenty of fluid should be given to increase urinary elimination. Stopping of diarrhoeas must be accomplished by morphine or opium, charcoal, bismuth, etc. Quiet and absolute rest should be induced by morphine.

RECURRENT UNILATERAL SUBLUXATION OF THE MANDIBLE, EXCISION OF THE INTERARTICULAR CARTILAGE

IN CASES OF SNAPPING JAW*

By ASTLEY P. C. ASHHURST, M.D.

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ILLUSTRATIVE CASE.—Frances G., aged sixteen years, was admitted April 16, 1920, to the Orthopædic Hospital, and referred to my care by Dr. F. W. Sinkler. *Previous history* was negative, except that she had had several teeth pulled, though without taking any anæsthetic, so it is probable no undue force had been employed.

Her *present condition* dated back for about two years; during this time unilateral (right-sided) subluxation of the jaw had occurred on an average of once a month, and for the last three or four months more frequently. It occurred at first only when eating: there would be severe pain in front of the right ear, the mouth would be locked open, and she would have to stop her meal at once. For a long time she could reduce the displacement herself without calling a physician, but one morning in January, 1920, the dislocation occurred at breakfast, and she had to call a physician because it was found that even with her chin bandaged the dislocation recurred, and even if she did not try to open her mouth. Subsequent to this date, though, a bandage was worn, the dislocation frequently occurred during sleep, and she would be awakened by the attendant pain. In one day she had to have five different doctors called in emergency to reduce the recurring dislocations; one time only, about a week before admission, was it necessary for the physician to administer an anæsthetic (chloroform) to reduce the dislocation.

By this time the frequent recurrence of the dislocation, and its occurrence with slight or no provocation, induced a hysterical state of high degree, and it was for this that she came under Doctor Sinkler's care.

On admission she wore a bandage holding her mouth shut, and she resolutely refused to attempt to open her mouth for fear of inducing the dislocation. This bandage had been worn constantly for weeks, and she was extremely hysterical, dishevelled, and miserable. For weeks she had taken only liquid food. If her teeth were separated even 0.5 cm. the dislocation would occur, with marked pain, and required manipulation for its reduction; dislocation occurred a number of times while she was in the hospital before operation.

X-ray examination by Dr. R. S. Bromer showed that when luxation was present the mandible on the affected side (right) rode for-

* Read before the Philadelphia Academy of Surgery, Feb. 7, 1921.

ward on the maxilla, as determined by the relative position of the molar teeth on the upper and lower jaws; but no abnormality in the joint could be detected.

The *cause* of the recurring subluxation of the jaw was a matter of some interest. The affection was first accurately described by Sir Astley Cooper (1822), and according to Malgaigne (*Traité des Fractures et des Luxations*, Paris, 1855, ii, 295), no one previously, except J. L. Petit, had recognized the possibility of anything less than a complete dislocation. The following is Cooper's description:

"*Subluxation of the Jaw.*"—"As in the knee the thigh-bone is sometimes thrown from its semilunar cartilages, so the jaw appears to occasionally quit the inarticular cartilage of the temporal cavity, slipping before its edge, and locking the jaw with the mouth slightly opened. It generally happens that this state is quickly removed by natural efforts alone; but I have seen it continue for a length of time, and the motion of the jaw, and power of closing the mouth, have still returned. This state of the jaw happens from extreme degrees of relaxation. The patient finds herself [note the sex] suddenly incapable of entirely closing the mouth. Some pain is felt, and the mouth is least closed on the side on which the pain is felt.

"Force for removing these appearances must be applied directly downwards, so as to separate the jaw from the temporal bone and to give an opportunity for the cartilage to replace itself upon the rounded extremity of the condyloid process.

"In extreme degrees of relaxation, a *snapping* is felt in the maxillary articulation just before the ear with some pain arising from the jaw suddenly slipping into its socket, which the relaxation of the ligament had permitted it to quit and to advance upon the zygomatic tubercle.

"Young women are most the subjects of this sensation, and the means which I have found most frequently and quickly ensure their recovery, have been ammonia and steel as medicine; with the shower-bath, and the application of a blister before the ear when the complaint has continued for a length of time."—"A Treatise on Dislocations and on Fractures of the Joints."

Cooper, it is seen, believed the lesion consisted in displacement of the cartilage from the condyle, the latter riding forward and leaving the cartilage in the glenoid cavity; whereas normally the cartilage is firmly attached to the condyle, and with it moves forward upon the eminentia articularis when the mouth is widely opened. And this seems the most reasonable explanation, inasmuch as a forward displacement of the cartilage upon the condyle could scarcely prevent closure of the mouth, though it might interfere with opening it.

In mild degrees the affection may be termed "snapping" or "clacking" jaw, a noise (audible to the patient and sometimes to bystanders) being made by mastication by the cartilage slipping around inside the joint. My own right temporo-mandibular joint is so affected, the clacking being most easily produced (painlessly) by lateral motions of the mandible. This is in accord with the facts pointed out by Pringle (*Brit. J. Surg.*, 1919, VI, 385, January), that whereas, motion between the cartilage and the temporal bone occurs in the sagittal plane in the movements of opening and shutting the mouth, yet the only motion between

the cartilage and the condyle is one of rotation. As the external pterygoid muscle is attached to the anterior end of the cartilage, Pringle believes that the disability is due to sudden violent action of this muscle displacing the cartilage forward and inward. Thus the thick central ridge of the cartilage (Fig. 1) he believes becomes placed obliquely, instead of lying in the coronal plane. He says he believes it is impossible for the disk to become displaced from the condyle, as it is so closely applied; but he noted in operating on one patient that the cartilage could be dragged freely over the condyle in whatever position the mandible was placed. He suffers from this recurrent subluxation of the jaw himself, and has encountered four patients (two medical students and two young women) with the same affection in a more or less aggravated degree. In the two women patients the affection developed gradually after the extraction of some teeth under anæsthesia. His mechanism for reducing the luxation when it occurs consists in keeping up hard pressure at the back of the condyle with the mouth open, and then slowly closing the jaw.

Whatever the exact cause of the dislocation, it is evident that the cartilage is at fault, and that the simplest and most certain cure must consist in the removal of the cartilage. Annondale (*Lancet*, 1887, I, 411), it is true, secured relief in two cases by suturing the cartilage to the condyle; but the analogous operation for subluxation of the semilunar cartilage in the knee has long since been abandoned, experience having shown that more certain as well as more lasting relief is secured by its excision. J. B. Blake (*Trans. Am. Surg. Assoc.*, 1918, xxxvi, 350) dwelt with undue emphasis, I believe, on the difficulty and danger of any operation on the temporo-mandibular joint itself, and certainly his theoretical objections to removal of the cartilage are not well founded. It is the obnoxious structure, and its removal, far from increasing the disability, brings relief. It is the same as with a loose cartilage in any other joint: when the cartilage becomes displaced sufficiently far, the joint locks. The operation adopted by Blake himself (suture of the coronoid process to the zygoma), while eventually successful in his patient, evidently was attended by no such prompt relief as in the present instance; and since a separation of the teeth even of 0.5 cm. in this girl was attended by luxation, it would have been manifestly impracticable to adopt Blake's plan in her case. Pringle secured complete relief in one patient by excision of the cartilage, and believes his operation is the only one of its kind on record.

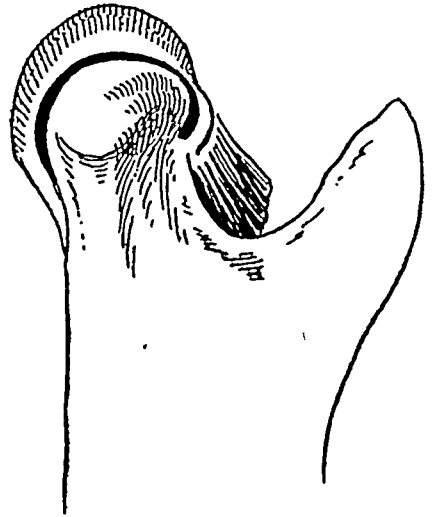


FIG. 1.—Showing intra-articular cartilage in temporo-mandibular joint. The artilage has been sectioned in the sagittal plane. Note its thickness in above condyle, and thinness anteriorly; also attachment of external pterygoid muscle.

SNAPPING JAW

Accordingly, after this girl's highly hysterical state had been somewhat subdued by hospital regimen under Doctor Sinkler's care, operation was undertaken May 1, 1920.

Under ether anæsthesia an incision was made over the zygoma, 2 cm. in length, backward to the auricle, thence downward for 3 cm. in front of the auricle. The masseter muscle was detached subperiosteally and the small triangular flap of skin and muscle turned down. The cartilage was easily identified, moving with the condyle of the mandible, but very loosely attached. It was caught in a sharp tenaculum, and excised with scissors. Bleeding was controlled by a temporary gauze pack. The incision was closed in layers, without drainage.

Convalescence was uneventful. On May 7th it was noted that she could open her mouth far enough to protrude her tongue easily, without luxation occurring, and she was allowed to eat vegetables. May 11th she was able to open her mouth 2.5 cm. easily; no luxation had occurred since the operation, and the girl's hysterics were gone.

Seen again in November, 1920. There has been no further trouble with the jaw, and the scar of operation can scarcely be seen even on close inspection. The mouth can be opened to full normal width, and normal power in mastication is present. The girl has had several more teeth pulled, and has been under nearly constant treatment, her mother informs me, by osteopaths, for a "lameness" and "pressure on the nerves of the spinal cord"; symptoms which are evidently hysterical in origin.

TREATMENT OF CARCINOMA OF THE TONGUE

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CARCINOMA of the tongue has proved itself to be one of the most difficult types of malignant disease with which to deal. The microscopic anatomy is rather uniform, but the clinical course varies extensively. On the whole, it may be said that growth is rapid and dissemination early. This is probably due to the rich vascular and lymphatic supply and to the constant movement of the organ. While it is relatively accessible, it is, nevertheless, much more fatal than many other more inaccessible types of cancer. It terminates fatally in 75 to 90 per cent. of cases, according to Warren, Butlin and Meller.¹ In frequency, Jessett¹ places it second only to carcinoma of the cervix, while Jacobsen¹ gives it third place. The average duration of life in untreated cases is less than two years.

In the treatment of this disease surgery alone has proved inadequate and unsatisfactory for various reasons. Many cases come to the surgeon in the inoperable stage, thereby leaving a large group in which surgery offers nothing; in fact, offers worse than nothing if an ill-advised operation is attempted. In our own series of cases only 27 per cent. were operable at the time of applying for treatment. This figure is, of course, too low as an average, because, especially in our earlier work, we received none but very advanced cases. It is encouraging to note, however, that more recently we are getting much earlier cases for treatment.

The location of the lesion on the tongue has a great deal to do with determining its operability. Bastianelli² has noted that those on the tip of the tongue are most favorable for operation, while of those at the base he has not seen a single cure and advises against operation if the growth be in this location.

We frequently see the primary lesion operable but the lymph-nodes inoperable. In a considerable percentage of cases, operable as far as the extent of the disease is concerned, the general condition of the patient is not sufficiently good to withstand the surgical shock. Many of these patients are suitable subjects for pneumonia or some other intercurrent infection following the radical surgical procedure. In view of these considerations, we see at once that surgery occupies a limited field in the treatment of the disease as a whole.

Within the operable field, surgical statistics vary to a considerable extent. Meller¹ found that operation prolonged life thirteen and four-tenths months, cured 14.6 per cent., and had a mortality of 13 per cent. Morestein³ placed the operative mortality at 20 to 25 per cent., Capetti⁴ at 11.6 per cent., and

TREATMENT OF CARCINOMA OF THE TONGUE

Poirier⁵ 25 per cent. In his series of collected cases, Bastianelli² found 11.6 per cent. well over three years. Butlin,⁶ in a review of 197 cases, found fifty-five, or 27.8 per cent., well from three to twenty-three years. Of those dead a much larger percentage were from recurrences in the nodes than from recurrence of the local lesion. He had no cases well following operation on recurrences.

In an analysis of 777 cases, Capetti⁴ found 18 per cent. free from disease over three years, and from a group of selected operators noted that this proportion was raised to 20 per cent. Caird,⁷ in an analysis of sixty hospital cases, found, at the time of his report, sixteen survivors. Of these, ten cases were well one year, and one each twenty, twenty-four, thirty, thirty-one months, seven years and eight years.

In a report of thirty cases from the Boston City Hospital, Lathrop and Scannell⁸ had two cases alive seven and five years, respectively, both from partial excisions. Of those dead, the longest period of life after operation was two years.

Cobb and Simmons,⁹ of the Massachusetts General Hospital, reported fifty-six cases of carcinoma of the tongue, thirty-four of which were operated upon. The types of operation ranged from the simplest to the most radical. The immediate operative mortality was 8.5 per cent., and of the thirty-four cases, four were alive and well at the time of the report, two cases thirteen years, one case six years, one four years, and another died of some intercurrent disease at the end of four and one-half years. Including this last case, their cures were 14.3 per cent. They have noted, also, that all of these clinical cures occurred in elderly patients.

In view of these collected surgical statistics it is quite evident that much remains to be hoped for in the treatment of cancer of the tongue.

In our own work we have divided the treatment of this disease into two distinct parts.

PART I.—TREATMENT OF THE PRIMARY LESION

In the treatment of the primary lesion we feel very strongly that surgery occupies no place, and that this part of the disease belongs entirely to the radium field.

In our earlier work with surface applications of radium we were, on the whole, disappointed; so much so that in the 1915 and 1916 report from the Memorial Hospital Doctor Janeway stated that "by the time carcinoma of the tongue becomes over one centimetre in diameter, the possibility of healing it with radium becomes uncertain."

Based on the knowledge at hand at that time, I believe his conclusion was correct as far as the use of radium on the surface is concerned. Only one of the four cases reported clinically free from disease in that report still remains well.

Shortly after that period we began burying radium emanation in the substance of the growth, and by this change in technic we feel that our results

have been immeasurably improved. In view of this alteration in technic the present report is made to cover a period of only a little over three years.

While we have not discarded surface applications of radium in tongue cancer, we feel that its use in this way is confined to the treatment of certain very superficial growths such as some of those beginning in leucoplakic areas, to the cases of basal-cell carcinoma which we very occasionally meet with in the tongue, and to supplementing doses of buried emanation. The bulk of our treatment rests entirely upon the use of buried emanation. For this purpose we use fine glass capillary tubes about three millimetres in length and 0.3 millimetre in diameter, each containing about one millicurie of radium emanation. I specify one millicurie, or slightly less, as being the most satisfactory strength to use at present. In our earlier work we used tubes of two, three, and four millicuries, but found that they produced too much necrosis of tissue.

Radium emanation decays at the rate of about 15 per cent. per day, so that the total value of one millicurie is equivalent to approximately 132 mc. hrs. of continuous radiation.

These weak tubes are buried uniformly throughout the growth by means of fine trocar needles and left *in situ*. In order to make this as painless as possible, the lingual nerve is injected with 1 per cent. novocaine, or, if the lesion be far back on the tongue, infiltration with novocaine is used. The dose of radium applied in this way depends, of course, upon the size of the lesion, although the average is probably from six to fifteen millicuries. The shape of the lesion also has something to do with the amount necessary, since it is quite evident that a bulky, spherical lesion requires relatively less than one of the elongated type extending for a considerable distance along the lateral border of the tongue.

Uniformity of distribution and accuracy of approximation throughout the growth are the all-important factors, and, in case the fixed number of tubes determined upon is insufficient to fill these requirements, it is advisable to use more tubes of weaker individual values.

While the use of radium emanation in this manner is, in many respects, comparable to the burying of steel or gold needles containing radium element, still there are certain features of difference. By the use of emanation tubes a more intense beta ray effect is obtained throughout the entire area, since the emanation is filtered only by the thin wall of the capillary tube which removes only the alpha rays. A very prolonged radiation of both beta and gamma rays obtained by this method is, we feel, superior to the shorter exposures of, mainly, gamma rays made necessary where metal containers with larger amounts of the element are inserted in the growth and removed after a few hours.

The tissue reactions incident to this very prolonged radiation over a period of weeks are very important. The amount of trauma is less and distribution can be made much more uniform and accurate by burying the emanation tubes.

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The emanation decreases in value at the rate of approximately 15 per cent. per day, so that in about four days one-half of its energy has been spent, while at the end of eight days approximately one-fourth of its activity is still present. It will thus be seen that radiation is carried out over a prolonged period without the discomfort to the patient of having foreign bodies, subject to being dislodged, projecting into the oral cavity. By this means the dosage can be very materially increased. In this particular connection I would warn those using needles containing the salt, that they should not attempt to equal the dose for emanation in carrying out a parallel technic with their metal needles.

By this method of treatment the radium reaction is both prolonged and intense, and is by no means painless, so that during its course every encouragement must be given the patient lest he feel that he is becoming worse rather than being benefited. Scrupulous care must be directed toward cleansing the mouth. Nourishment must not be decreased, and the patient's general physical condition must be kept at as high a level as possible.

PART II.—TREATMENT OF THE CERVICAL NODES

In the treatment of the cervical nodes we have taken a very conservative position and at the present time feel more strongly convinced than ever that this has been wise. The chief criticism I feel we should make of ourselves is that perhaps we have not followed up external radiation sufficiently. More recently we have been radiating the neck externally with radium in all of our favorable cases. In those having no enlarged nodes, this measure is used with the idea of destroying minute metastatic foci as well as by stimulating the protective defenses in the lymphatics, and, in those where palpable nodes have already appeared, with the hope of rendering the disease in this location temporarily less malignant, and therefore a safer operative risk. By external radiation alone we do not feel that we have ever been able to destroy, completely, epidermoid carcinoma in the cervical nodes.

We feel that the lymphatics of the neck perform a conservative function and represent one of nature's barriers to this disease, and that unless definite involvement is noted they should not be interfered with surgically. A very considerable percentage of cases do not develop metastases in the neck at all or until late in the course of the disease. This is especially true in elderly patients. The routine block dissection as commonly practiced does not remove all of the possible avenues of dissemination. It does, however, remove one of nature's chief barriers, frequently at a time when such are needed most. Many patients are not physically able to withstand such an operation. If extension to the cervical nodes be embolic, as most of us believe, then it is quite possible that a great deal of needless surgery, with its resultant surgical shock, may be carried out and still the one small dangerous focus left unnoticed, but probably stimulated to greater activity.

In cases where no cervical nodes are palpable, our plan has been to do nothing, or confine our treatment to external radiation only, and keep the

patient under observation. If a palpable node appears, which is clinically malignant and not simply inflammatory, we then do a complete dissection of that side of the neck under local anæsthesia, removing the entire chain of nodes and burying small doses of radium emanation well distributed in weak tubes at all suspicious points in the wound, and especially at the points where the lymphatic channels are severed. By burying the emanation in this way we get a very uniform radiation throughout the entire operative field, carried over a prolonged period and without appreciable gross destruction of tissues. Healing of the wound is complete before the intensity of the radiation becomes apparent.

In our operative work I believe we are now becoming more conservative than we were at first. For example, in cases where the lymphatic mass has perforated the gland capsule of the node and is invading surrounding structures, such as the sternomastoid muscle or the great vessels, it is better to bury radium emanation uniformly throughout this mass, in the same manner as previously described, and close the wound. With the parts exposed in this way, accurate approximation of the radium can be made, and nature's barriers are left intact. The metastatic mass thus left intact affords a support for the emanation tubes such as could not be obtained in any other manner.

While we sometimes see remarkable clinical cures following the surgical removal of such masses, still, I believe that these are more or less accidental and that as a whole the results are very unsatisfactory. In certain cases also, where a single node appears late in the course of treatment, and is well confined to either the submaxillary or deep cervical groups, we are inclined to do a limited dissection of one or other group, as the case may be, burying the radium as before, after removal of the entire chain of glands in this group and leaving the other group intact. This in no way complicates the dissection of the other group at a later date if that is found necessary, and in a great number of cases in our experience, to date, it has not been necessary. Here again, a great deal depends upon the embolic theory of extension to the nodes, and I mention it as being one of the problems now under our consideration and toward which we are favorably impressed but in which we have not as yet arrived at a final decision. When the neck is exposed surgically we take advantage of the opportunity to ligate the vessels supplying the primary lesion. The lingual and facial arteries are ligated separately and in addition we always ligate the external carotid just above the superior thyroid branch. This cuts off a great deal of anastomotic circulation and, as Küster pointed out some time ago, ligation of the external carotid is no more dangerous than ligation of its branches. I do, however, favor its ligation above the superior thyroid branch, so that the nutrition of the thyroid will not be interfered with.

I should like to emphasize the doing of the neck dissection under local anæsthesia. It does away with post-anæsthetic pneumonia, hemorrhage is better controlled, more careful work can be done, and many patients may be cared for in this way who could not withstand a general anæsthetic.

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STATISTICS OF TREATED CASES

During the past three and one-half years we have treated at the Memorial Hospital 148 cases of cancer of the tongue. A large percentage of these were very far advanced and some of them, I believe, would have been better had no treatment been given. There comes a period in the course of the disease when we must recognize the fact that it is even too late for the palliative use of physical agents.

In this series of cases 134, or 90.5 per cent., were in men, and fourteen, or 9.5 per cent., in women. This, I believe, is rather a low proportion of females. Piquantin¹ found from an analysis of collected cases that 17 per cent. of cancer of the tongue appeared in women. A history of syphilis was obtainable, either in the direct clinical history or by a positive Wassermann reaction, in 35.1 per cent. of all cases. This would probably have been higher had a Wassermann reaction been done in every case. Nearly all of the men were excessive tobacco smokers, 84.5 per cent. of all cases giving a history of its use. Bad and irregular teeth were very common throughout. All of the women had a very definite history of dental irritation, excepting one, and this one had a positive Wassermann reaction and leucoplakia of the tongue.

The average duration of the disease in this series was 6.72 months, the rather high average being due probably to a few long-standing cases of one to seven years.

Of the series there were sixty-nine cases, or 45.8 per cent., primary growths without nodes, and of these only thirty-four, or 23 per cent. of the total, were classed as surgically operable. Of these thirty-four cases, twenty-nine, or 85.3 per cent., are now clinically free from disease for periods of two months to over three years from the time of beginning treatment. One died a year after treatment was begun with recurrences both locally and in the nodes. One left our service eleven months after treatment was first given, was operated upon elsewhere, and when last heard from was still free from disease. One patient was lost track of after six months. One died of diabetes one and a half years after treatment, with no clinical evidence of carcinoma present, and the fifth died eighteen months after his first treatment from extension to the neck, which he refused to have treated as we had advised.

Of these thirty-four primary operable cases without nodes, five subsequently developed cervical metastases. All were treated by the procedure previously outlined, and three are now clinically free from disease. As stated above, one died a year after treatment with both local and cervical metastases and the other was lost track of at the end of six months. Of this same group thirty, or 88.2 per cent., were verified by microscopic sections.

Of the primary cases coming to us with nodes at the time of admission, only three cases, or 2 per cent. of the total, were operable at this time. These were treated as previously outlined and all three are now clinically free from disease.

The total number of primary cases coming to us with and without nodes

at the time of admission was 128, or 86.5 per cent. of the total series. In a large number of these cases either the extent of the primary lesion or of the cervical nodes rendered the case surgically inoperable.

Of the recurrent cases applying for treatment there were twenty, or 13.5 per cent. Six of these had recurred locally only. Four recurred in the nodes only, while ten were recurrent both locally and in the nodes. Three of these cases were surgically operable. They were all local recurrences and were treated locally by burying radium emanation. Two are now clinically free from disease for periods of two and one-quarter years and one and three-quarter years, respectively, while the third has been lost track of.

Of the total series forty cases, or 27 per cent., were operable at the time of admission, and of this group there are at present thirty-four cases, or 85 per cent., clinically free from disease for periods, as previously mentioned, ranging from two months to three and one-half years.

Of the total series positive biopsies were obtained in 133 cases, or 89.8 per cent.

As to the method of treating these primary lesions, most of it has been by the burying of radium emanation tubes. One hundred and twenty-eight cases were treated by this method alone. In five cases surface applications of emanation filtered by 0.5 millimetres of silver and held in place by an applicator made of dental modelling compound was the only method of treatment. In nine cases a combination of buried emanation and surface applications was used. Two primary lesions were too advanced for any form of treatment, and four recurrent cases involved the nodes only.

External radiation to the neck, with heavily filtered radium, has been used in twenty-four cases, or 16.2 per cent. In those cases developing cervical nodes after treatment to the local lesion, the average time between the primary treatment and the gland appearance has been a little over four months, the extreme ranges being six weeks to twelve months.

Of the entire series, neck dissections as previously outlined, combined with the use of radium in the wound, have been done in fifty-eight cases, or 39 per cent. Of these there have since been recurrences in fifteen cases, or 25.8 per cent. of the operated series.

There are to date, in our total series, forty-three cases, or 29 per cent., clinically free from disease for periods ranging from three months to over three years, as follows:

Six cases clinically free from disease three to six months; seven cases clinically free from disease six to twelve months; thirteen cases clinically free from disease twelve to eighteen months; six cases clinically free from disease eighteen months to two years; seven cases clinically free from disease two to two and one-half years; four cases clinically free from disease two and one-half to three and one-half years.

In addition there are eighteen cases where radium caused a complete retrogression of the primary lesion but in whom there were hopeless neck recurrences.

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Adding these, therefore, to the previous group of cases clinically free from disease, we have sixty-one cases, or 41 per cent. of all the local lesions showing complete retrogression. There are nineteen cases, or 12.8 per cent., still improving but not as yet free from disease. Fifty-eight cases, or 39 per cent., are dead, although three of them were clinically free from carcinoma at the time of their death. One case died of diabetes, another of pneumonia, and a third of cardiorenal disease. Twenty-one cases, or 14.1 per cent., have been lost track of so that we must add them to the unfavorable group. Seven are still living but are gradually becoming worse. Twenty-one cases, or 14.1 per cent. of the entire series, were, in my opinion, unimproved by treatment. These were cases with very advanced disease, in most instances extremely advanced both locally and in the regional glands. I believe they would have been better off for the remaining short period of life left to them had no radium been used. Many advanced cases, however, were benefited for a time.

Of the group of cases clinically free from disease at the present time the average age is fifty-seven and seven-tenths years, the extreme ranges being thirty-two to seventy-eight years.

CONCLUSIONS

In our opinion the primary lesion in cancer of the tongue should be managed entirely by the use of radium. The use of buried emanation in weak tubes uniformly distributed throughout the growth is by far the method of choice in applying the radium. The cervical nodes should be treated conservatively: First, by external radiation where the neck is free from palpable involvement, and then, should metastases appear, the treatment of these should be by external radiation, followed by a complete neck dissection under local anæsthesia, coupled with the use of radium emanation in very weak tubes buried throughout the wound.

While the time factor is still too short to permit of comparison with surgical statistics, we feel convinced that this form of treatment in unselected cases will yield a higher percentage of clinical cures than will surgery alone in the selected operable group.

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BENIGN STENOSIS OF THE ŒSOPHAGUS

WITH A REPORT OF EIGHT CASES*

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WHEN a child or an adult presents himself with the story of loss of weight coupled with difficulty in swallowing, some obstructive cause is at once suggested. Passing over the various causes, such as abscess, polyp, diverticulum and bulbar palsy, and not forgetting mediastinal tumors and aortic aneurism, one thinks of direct obstruction by stenosis; benign, malignant or spasmodic; or by a foreign body. Foreign bodies can usually be indicated or ruled out by the immediate history. The particular kind of stenosis must be detected by the more remote history, the age and character of the patient, and the symptoms. Leaving out the spasmodic and malignant stenoses with which this paper does not deal, we have the benign cases remaining. In the benign stenoses we have a class of cases usually young and in whom the outlook is hopeful. Much, one might almost say everything, can be done for them surgically, and the results are pleasant to consider.

The history of the average case dates back some months, it may be years; it may even be to birth. A little child creeping on the floor reaches out and swallows some lye or strong caustic; or by mistake an adult drinks some acid. The first effect is a burning of the mouth, throat and gullet. Frantic efforts are made to give an antidote, but before one can count ten the mucous membrane of the hollow tube is damaged beyond the reach of antidotes. Then comes a time when only soreness persists; and with soothing fluids and fluid food all seems to be going well, till one day the patient finds upon attempting it, he cannot swallow solid food. Later the thicker fluids and then even water only will pass, and that with sluggishness. For the early symptoms the patient seeks the practitioner; for the later symptoms and often sadly the much later symptoms the practitioner seeks the surgeon. By this time the stenosis is so tight the surgeon's task is rendered fourfold more difficult.

In the hands of the more fortunate the patient is placed under curative procedures earlier—before the stricture has closed and while still fluids pass easily. Scar tissue and pericæsoophageal adhesions cause the mischief.

The locality of the stenosis is more frequently at the lower end of the œsophagus—the epicardia: less frequently opposite the tracheal bifurcation and least frequently opposite the cricoid cartilage. The cause of this is probably the rate of speed a swallowed mass traverses the gullet. The greater speed is at the entrance; it slows down about the middle,

* Read before the New York Surgical Society, March 9, 1921.

and pauses for a brief moment before discharging into the stomach. Lerche quotes Schreiber in support of this contention. The site of these stenoses also corresponds approximately to the natural narrowings of the œsophagus. These, according to von Hacker, as cited in Lerche's article, occur most constantly "at the level of the bifurcation of the trachea or somewhat above; at the beginning of the organ or closely below; and on a level with the hiatus œsophagus: but one or more of these may be absent."⁷

It may, then, be the difference in speed coupled with the physiologic constrictions which determines the site of the strictures. After watching the rate of flow by means of the fluoroscope it seems probable that the rate of speed has most to do with causing the lesion.

Lerche says the bolus arrives at the stomach in from seven to ten seconds; Carman places it from two to ten seconds.¹¹ From my own observations, together with Doctor LeWald's, I would place the time interval at two to five seconds, varying with the consistency of the mass ingested. Undoubtedly desire and the size of the bolus may influence the speed and "the propelling force of the peristalsis may come to a momentary halt by retching and vomiting." Other things being equal, the slower the speed the deeper the burn and the worse the stricture.

The symptoms have been briefly noted earlier: here they may be repeated. The cardinal ones are dysphagia, regurgitation, emaciation, hunger, thirst, weakness and constipation: this last from lack of material taken in. Occasionally cough and apparent salivation are secondary. The cough may come from an accumulation of saliva spilling over into the larynx or from irritation of the vagus nerves from pressure lower down.

The diagnosis is confirmed by the absence of splash sound on swallowing water; by the röntgenogram; the œsophagoscope; and the bougie. The writer prefers to have a preliminary röntgenogram taken before any instrumentation. (In his cases he has been greatly assisted by the able coöperation of Doctor LeWald.) Occasionally this procedure is not a feasible; but it is a safe rule. If it is done the œsophagoscope cannot be used to advantage the same day on account of the residue frequently remaining to obscure the field of vision. Position will help in œsophagoscoping these patients (Killian).² Examination by the Röntgen ray is most desirable, but is not complete without further aids. The œsophagoscope must finish it off, and the bougie or bulbous sound, which is most dangerous in the hands of the inept, is at this point a material aid when used through the tube of the œsophagoscope. By it one may determine the "feel" and the character of the constriction. When the diagnosis has been made both as to the nature, the locality, the extent and tightness of the stenosis, one can determine what method of attack he is to pursue.

The approaches are per oral (Lerche, Lanelongue, Plummer, Jackson

and Abbe), abdomino-oral (Abbe and Billroth), and transthoracic (Gossett³ and Fischer⁴).

The methods may comprise dilatation, or cutting or a combination of both.

In this class of cases the coöperation of the patient is most important; and this is generally obtained even in the case of young children, due to their dire necessity. Much help and an additional factor of safety may be gained by the swallowing of a silk thread. This is true whether the attack is through the mouth or through a combination of the oral and abdominal route. A guide in the canal is always a help. It may even give aid in using the endoscope. One cannot always persuade the infant to swallow a thread. In such cases a whalebone filiform bougie can be passed through the minute opening by direct vision, with the aid of the œsophagoscope (R. Abbe⁵ and N. W. Green⁶). The canal above the stricture is always basin shaped—below it, funnel shaped. In the röntgenogram this very feature is of great diagnostic aid in differentiating a benign from a malignant stenosis.

Abbe says it has "been demonstrated by Albert, Billroth, von Bergman, Maydl, and others that an œsophageal stricture which permits no bougie to enter from above will almost invariably permit it from below."

It is very difficult even by means of an endoscope to locate the cardiac end of the œsophagus from within the stomach. Abbe also has called attention to the difficulty of locating it by means of the palpating finger within the open stomach.

The method of cutting the stricture with a string used with a sawing motion while a retrograde bouginage was being carried out was devised by Dr. Robert Abbe some thirty years ago.⁷ I have found it safe and a most satisfactory procedure, especially in the strictures of some two and three inches in length. A gastrostomy preferably of the Senn-Kader type is a requisite, and fourteen days should elapse after its establishment before the attempt is made to carry out the Abbe procedure. The retrograde bougie of Billroth is contributory to carrying this out. One string tied in the eye advances the bougie and another passing alongside does the string sawing while the stricture is placed on the stretch by the bougie. This subjects only the strictured part to the attrition of the string. String cutting from above has also been practiced by Abbe with a string passing down through the mouth and back again over the shoulder of a tapered bougie.

Chevalier Jackson has used this procedure in modified form with the string cutting only on one side of the olive. He determines to which side to apply the cutting by means of the œsophagoscope. He applies the cutting to the side of the stricture which stands out farthest into the lumen of the œsophagus.⁸

A forcible dilatation of these stenoses by passing graduated olives, whose ends are armored with an insinuating spring tip, over a string six

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yards long, most of which has been passed into and beyond the pylorus, after the method of Dunham and Mixer, has been advocated by Plummer.⁹ He says it is the purpose of his paper, written in 1910, "to again call attention to the value of a silk thread as a guide in dilating cicatricial stenosis," and to prevent the more general use he made of it during the five years previous to 1910, in the study of about three hundred lesions involving the œsophagus. In his group of cases cited, he had eight cicatricial stenoses at the cardia. Plummer says: "Inability to differentiate obstruction from narrowing, and obstruction from pocketing, is responsible for the greater part of the reported mortality of from 10 to 15 per cent. from perforation, in cases of cicatricial stenosis; and the not infrequent deaths (not often reported) in cases of carcinoma and other œsophageal lesions following the usual method of passing sounds."

This method has not been used by the writer, but it is appealing and practical. It should always be preceded by röntgenograms and an œsophagoscopy. Aortic aneurism and varices may be pitfalls to cause regret. In 1865 Lanelongue performed internal œsophagotomy with an instrument similar to that of Maisonneuve. The stenosis was at the upper end. A beautiful description of his experience will repay anyone for looking it up.¹⁰

A very comprehensive article on this condition was published by William Lerche in 1909. By his method the stricture is divided through the œsophagoscope by a guarded cutting knife. It has many advantages.

When the strictures are not tight and are situated at the epicardia it has been possible to pass a small bougie through them by the aid of the œsophagoscope. This can then be followed with Lerche's glove stretching dilator without cutting. Force is to be avoided and it is better to repeat the process than to do too much at the first sitting. The writer has done this in three cases with much satisfaction.

All these methods require occasional bouginage; at first often, later ranging from one month to three or six months' intervals.

Brief records of my cases are herewith appended.

CASE I.—D. B., female, aged three and one-half years, was admitted to the service of Doctor Abbe, St. Luke's Hospital, November 26, 1911, with the diagnosis of œsophageal stricture. (This was Doctor Abbe's case in which I had the privilege of coöperating.)

Nine months before admission she swallowed some potash. From that time until admission there was a constantly increasing stenosis of the œsophagus. Finally everything taken into the mouth was regurgitated. Emaciation was most evident.

On November 27, 1911, a gastrostomy by inversion of the stomach wall by repeated purse-string sutures was performed by Doctor Green. On December 22, 1911, the string-cutting dilatation of the œsophageal stricture was performed by Doctor Abbe with the aid of a filiform bougie which was passed through the stricture under direct vision through the œsophagoscope by Doctor Green. To this

filiform bougie a silk string was attached at the gastrostomy end and in turn brought out through the mouth. The stricture was opened up to a No. 29 F. bougie.

On December 26, 1911, she was discharged cured.

She came back some months later and had gained weight and could eat crackers.

CASE II.—C. D., male, aged three years, was admitted to the service of Doctor Abbe, St. Luke's Hospital, September 11, 1911, with the diagnosis of stricture of the œsophagus. (This was Doctor Abbe's case in which I had the privilege of coöperating.)

The history stated that the patient swallowed some concentrated lye April 11, 1910. He swallowed solid food for a short time after the burn had healed somewhat. The growth came on gradually. Later everything solid would come back immediately after an attempt to swallow.

A gastrostomy was performed on September 14, 1911. On November 3rd, and December 22, 1911, the string-cutting method of Doctor Abbe was carried out by Doctors Abbe and Green with the aid of a fine whalebone bougie passed under direct vision through an œsophagoscope. To the lower end of this filiform a silk thread was tied which was then drawn out through the mouth.

(The patient was in the hospital a much longer time than usual and was confined in the isolating ward from June 29, 1912, to July 13, 1912.)

The gastrostomy wound evidently did not close spontaneously and was closed by Doctor Schley on July 22, 1912. On August 17, 1912, he was discharged cured.

CASE III.—J. D., male, aged three years, was admitted to Surgical Division A, St. Luke's Hospital Service of Doctors Abbe and Martin, February 23, 1915, with the diagnosis of stricture of the œsophagus. The history on admission stated that the patient swallowed lye five months previously. Several röntgenograms were taken, but the findings were unknown to the parents. He had evidently been at another hospital. A note is made that a bougie No. 16 passed nine inches. By the Röntgen ray it was impossible to determine the calibre of the supposed stricture as the patient refused to take solid food. The liquid bismuth mixture passed into the stomach.

On March 5, 1915, an œsophagoscopy was performed by Doctor Green. The pathological findings were as follows: Stricture seen in the œsophagus, but the lumen not sufficiently occluded to warrant gastrostomy. (The stricture was at the epicardia.) Graduated bougies were passed through the œsophagoscope with the hope of dilatation. The patient was returned to the ward for further treatment by dilatation. On May 4, 1915, the patient was again œsophagoscoped and the stricture ten inches from the upper teeth was dilated through the tube to a bougie 6 mm. in diameter. On May 22, 1915, an œsophagoscope was again passed. There was a slight stricture detected at the upper end, and this was dilated and

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the 'scope passed to the lower end and the main stricture dilated through the instrument to a 32 bougie. The tip of the above was passed into the stricture. He was discharged on July 16, 1915, improved.

On August 14, 1917 (two years later), he was readmitted after a history of vomiting two days, no loss of weight. On August 24, 1917, under light general anæsthesia an œsophagoscope was passed by Doctor Green and the stricture in the lower end of the œsophagus was dilated with a Lerche's dilator through the tube to about the size of a 32 F. bougie. He was discharged cured on August 26, 1917. Since then he has been dilated twice a year with a bougie.

CASE IV.—A. L., female, married, aged twenty-six years, was admitted to St. Luke's Hospital on April 29, 1916. The history on admission was somewhat as follows: When eight years old the patient drank some lye by mistake. She was treated by an outside physician for a year and then came to St. Luke's where the "string-cutting operation" was performed by Dr. B. Farquhar Curtis. This relieved her for eight years and then she began to have difficulty in swallowing; for the past four years she has been coming back and having bougies passed. Five days previous to admission the stricture had closed to the point where she could not swallow solid food, and two days ago she could not swallow fluids. She has lost weight and has become anæmic and weakened.

On April 29, 1916, the stricture was found through an endoscope to admit only a small filiform. It was dilated to 24 F. with bougies through a tube. It was probably three or four inches in length and was at the lower end of the œsophagus. The patient was somewhat intractable, and although eating soft food with discomfort, she did not consent to reënter the hospital till 1917, when she was readmitted on February 26th. As the dilatation of the stenosis from above was not satisfactory on account of the length of the cicatrix, another gastrostomy was performed on February 28, 1917. This was of the Senn-Kader type, and it was interesting to note the firm adherence of the stomach to the anterior abdominal wall at the site of the old gastrostomy made many years previously.

On March 14, 1917, an unsuccessful effort was made to pass the stricture from below. On March 20, 1917, a string which the patient had swallowed two days before was found protruding from the gastrostomy. The stricture had narrowed about the string and the smallest bougie passed with difficulty. With graduated Billroth bougies and the string-sawing method of Doctor Abbe the stricture was opened to the size of 41 F. A piece of tissue obtained at this time gave the following microscopical appearance as reported by Dr. Francis C. Wood: "The section shows a very thick layer of stratified squamous epithelium, underlying which there is a very fibrous connective tissue that is hemorrhagic and richly infiltrated with small round cells and many polymorphonuclear leucocytes. There are no glands in the section."

She was discharged improved on April 2, 1917. She was read-

mitted on December 11, 1919, with the following history: Since last admission (two years and nine months ago) the patient has had regular dilatation with the bougie every five or six weeks and on October 24, 1919, a 42 F. bougie passed readily. One day ago Doctor Green was unable to pass any bougie to the stomach, so patient reentered for further treatment and observation.

On December 12, 1919, bougies were passed repeatedly; 36 F. passed, but not as far into the stomach as previously. On December 15, 1919, she was discharged improved.

(She has since that time been returning to the office for bougie treatment about every six weeks, and by a specially designed bougie with an electric light in the end the passage of the instrument into the stomach can be readily determined by the transillumination.)

This case has been presented before the New York Surgical Society in November, 1917.

CASE V (Fig. 1).—K. M., female, aged two years, was admitted to St. Luke's Hospital, Surgical Division A (Doctor Martin and Doctor Downes), with a diagnosis of pyloric obstruction, February 16, 1917. At that time there was no operation and she was transferred to the Medical Division.

Her history on admission gave her chief complaint as inability to swallow with vomiting soon after taking food. Ever since birth she had been troubled with regurgitation. She could take milk, but very little solid food. Lately she seemed to vomit everything. Nothing seemed to enter the stomach. If water or milk were given very slowly it would seem to go down all right, but on drinking from a cup she could not keep anything down. She has never gained much weight, and in the last two weeks she has seemed to lose weight rather rapidly. She had been down at the Babies' Hospital for one week with no improvement. She was very constipated. The family history showed the mother to have had two miscarriages.

The röntgenographic report by Doctor LeWald, February 17, 1917, stated that the findings suggested pylorospasm or stenosis. There was a large five-hour residue. The findings were sufficient to justify surgical intervention for the relief of the stomach retention. After twenty-four hours and forty minutes there were apparently traces of the bismuth still remaining in the stomach. "This would offer definite indication for operative procedure." February 26, 1917, the following note was made by Doctor LeWald: X-ray examination points to pyloric obstruction, but manner of vomiting indicates some obstruction or diverticulum of the œsophagus. Patient transferred to Pediatric Service for treatment and observation.

She was admitted to the Pediatric Service (Doctors Collins and Gould) February 26, 1917, where she remained under careful feeding until June 24, 1917, and was much improved. So much so that she appeared strong and vigorous and walked and played around the ward. She vomited occasionally, and it was impossible

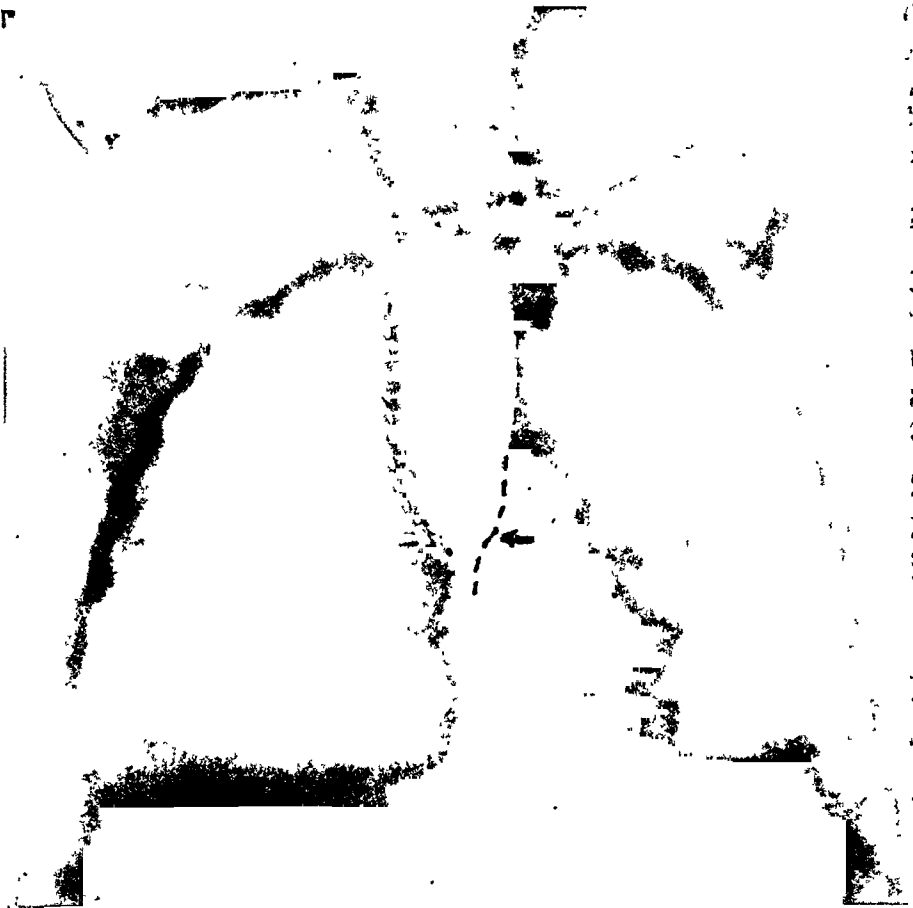


FIG. 1.—Case V. Benign stenosis of œsophagus (congenital.) Note the basin-shaped tendency of the dilated portion of the œsophagus. (Röntgenograms by Dr. L. T. Le Wald.)



FIG. 2.—Case VIII. Spring tip of bougie in the descending portion of duodenum. (Röntgenogram by Dr L. T. Le Wald.

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to pass a stomach tube except at long intervals. The gain was splendid at times, but stationary during the latter weeks.

On September 28, 1917, she was readmitted to the Surgical Division A (Doctors Martin and Downes), with the diagnosis of potential stenosis of the pylorus with adhesions and stricture of the œsophagus.

On November 30, 1917, a posterior gastroenterostomy was performed by Doctor Downes. Among the pathological findings at operation was a tight band of adhesions, probably congenital in type, extending from the flexure of the colon over the pylorus and well down to the posterior border of the liver past the neck of the gall-bladder. This was a very tight band and bound the pylorus well down to the posterior wall; it was also attached to the pylorus at a point where it passed over. At operation this band of adhesions was freed and cut away almost in its entirety, thus allowing the pylorus to come up anteriorly without constriction. Some improvement followed this abdominal procedure, but still the child regurgitated, and in the spring by the courtesy of Doctor Downes the patient was turned over to Doctor Green for œsophageal observation and treatment.

On May 29, 1918, an œsophagoscopy was done, and a stricture was located in the œsophagus near the cardia: it was almost pin-point in size. It was dilated with a small bougie through the tube.

On October 7, 1918, the stricture was again dilated through the œsophagoscope with bougies.

On April 27, 1919, the patient was discharged. Able to swallow fairly well.

(She has been to the office about every three months since and is practically cured.)

CASE VI.—A. S., male, aged forty-eight years, was referred to Doctor Green by Dr. F. S. Mathews and was admitted as a private patient to St. Luke's Hospital, January 16, 1918. The diagnosis was stricture of the œsophagus. About four months previous to admission the patient, after exposure to the cold, drank sulphuric acid in mistake. Dysphagia progressively increased, and when first seen he could only swallow fluids and that with hesitation.

A röntgenogram taken by Doctor LeWald showed a tight stenosis of the lower one-third of the œsophagus, with the basin-shaped dilatation of the œsophagus above the constriction, which is characteristic of benign stenosis. He had a gastrostomy performed January 17, 1918, and later was dilated by the Abbe string-sawing method three times up to a 45 F. bougie.

At first, after leaving the hospital, he had his stricture dilated about every week, then each month, and later every three months, six months twice, and recently he went a year without bouginage. He is now cured.

CASE VII.—R. G., male, aged twenty months, was referred to Doctor Green by Dr. F. O. Virgin and was admitted to St. Luke's

Hospital on September 27, 1920. The diagnosis was œsophageal stricture.

The history on admission was as follows: He was unable to eat. About two months ago the child swallowed some lye. The mother gave it white of egg which it vomited. For several days the child seemed to have pain on swallowing. Since that time he had been able to eat only soft foods. For the past week the child had been able to take nothing by mouth. Family history negative.

September 28, 1920, an œsophagoscopy was performed by Doctor Green. The pathological findings were as follows: There was a slight ulceration and a narrowing of the œsophagus just above the cardia. Operative procedure was as follows: The œsophagoscope was passed under ether anæsthesia and the œsophagus investigated. The cardiac was dilated with a small bougie and also with Lerche's expansion dilator up to 30 F. October 1, 1920, the patient was discharged cured.

(The patient has been back once for a bougie in routine.)

CASE VIII (Fig. 2).—H. P., male, aged two years, was referred to Doctor Green by Dr. Robert Abbe and was admitted to the Surgical Service, Division A, St. Luke's Hospital, October 27, 1920, with the diagnosis of foreign body in the duodenum and stricture of the œsophagus.

The history on admission was as follows: The patient showed an inability to swallow solids. At the age of seven and one-half months he was said to have had diphtheria with symptoms of nasal obstruction. When eleven months of age, he regurgitated breast milk more than previously. He was then weaned, and it was found that he could not retain solid food. He was able to swallow, but there was apparently a low obstruction, above which the œsophagus filled up until the child vomited. There was no history of drinking lye. The child was otherwise well. He had not gained in weight as much as he should. He had no pain: gagged at night and took liquids well. The mother was told by the physician who had tried to dilate the œsophagus that a bougie tip had broken off and been lost, but that the child would surely pass it normally. He had not done so to date (November 9, 1920).

October 29, 1920, X-ray examination by Doctor LeWald showed that fluid mixture had apparently entered the stomach, indicating no obstruction in the œsophagus. The stomach was emptying at a fair rate. October 29, 1920, X-ray examination showed that there was a foreign body in the abdominal cavity. It was dense and of metallic nature, measuring about 8 cm. by 3 mm. At the upper end it was slightly rounded, while at the other it was square. It had the appearance of a portion of a probe. It appeared to be outside of the stomach and gave the impression of being entirely outside of the digestive tract.

November 3, 1920, X-ray examination showed that the body was still present and had not changed its location. The body retained

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its vertical position with the round end upward about in the median line.

November 9, 1920, the foreign body was removed by Doctor Green by a laparotomy. The tip of a dilator was removed through an opening situated on the cephalad end of the foreign body, which was in the duodenum, vertically. The upper end was one inch from the pylorus. The duodenum was closed in the usual manner and the abdominal wall without drainage. An œsophagoscope was then passed and the pathological findings were as follows: The œsophagus bled easily. There were some irregularities in the lower pharynx. The cardia was slightly constricted but not closed. The œsophagoscope passed rather easily after its introduction into the introitus. The cardia was dilated with Lerche's dilator to 30 F.

December 2, 1920, the patient was discharged cured.

(The patient has been to the office twice in routine since leaving the hospital.)

Further History.—After leaving the hospital the patient ate solid food till the latter part of January. Now, March 9, 1921, he takes only fluids. He has, however, gained two pounds in the past month. To-day in my office a 30 F. bougie passed easily.

SUMMARY

In all there were eight cases. Two were adults; six were children three years old and under.

One adult stenosis was due to sulphuric acid. One was recurrent after being treated in childhood.

One was without history of burn, and was unquestionably congenital. It was coupled with stenosis of the outlet of the stomach.

One in an infant gave the history of coming on after diphtheria.

All eight are improved. All but one are cured with the necessity of occasional bouginage. One requires at the present writing further slight dilatation by the oral route. Four had the string-sawing operation of Abbe. These were the worst cases and have done very well. Four had dilatation through the œsophagoscope and were not treated so vigorously. The results are as good, but all kept track of are dependent upon following up with the bougie.

The longest interval in the last six cases in which the bougie has not been passed is a year.

In the milder types of stricture dilatation through the œsophagoscope is sufficient. In the severer types the string-sawing operation of Abbe is indicated.

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MECHANICAL FACTORS IN THE MANAGEMENT OF RECENT EMPYEMAS *

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IN the treatment of empyema, our aim is to preserve life, to avoid permanent sinus and to bring about healing as quickly as possible. With preservation of life foremost in our minds at the beginning of treatment, we will often find it inadvisable to do a thoracotomy at once. In desperate cases, with septicæmia, pneumonia of the same or opposite lung, circulatory embarrassment or even extensive bronchitis, delay will be safer for the patient. The immediate indication is best met by aspiration of as much fluid as possible once or maybe several times. By aspiration, the lung is put in a position to be in some degree functional instead of being thrown for a time out of employment.

But the aspiration treatment has its limitations. Some empyemas, especially the pneumococcus ones of children, begin with a solid exudate which later liquefies and in many of these cases there is so much fibrin in the exudate that aspiration in the sense of keeping the cavity empty is difficult or impossible. Aspiration, too, has its dangers. At times the lung is punctured so that air is pumped through it and produces pneumothorax or subcutaneous emphysema. When this condition develops, free incision is indicated at once to relieve the circulatory and respiratory embarrassment. The aspiration treatment lends itself well to the treatment of some of the streptococcus cases. In a recent case, in a young girl, a single aspiration removed two litres of thin streptococcus pus. Two days later thoracotomy under local anæsthesia was easily borne and healing was complete in three weeks. I have seen a streptococcus empyema apparently cured by repeated aspirations only to have the opposite lung develop an abscess which later ended fatally. Nor is it likely that repeated aspirations, accomplished without the entrance of air, delay the time of final healing, even though they postpone thoracotomy, for there is no better means available of bringing a compressed lung into immediate contact with the chest wall. As a general proposition, the thinner the exudate, the more suitable the aspiration treatment and the greater are the objections to the opening of the chest wall—such as flapping of the lung and displacement of the mediastinum. When the exudate is thick and fibrinous, we expect to find a definitely lined cavity, that is, there are adhesions sticking the lung to some of its surrounding

* Read before New York Surgical Society, March 24, 1920.

structures so as to steady the mediastinum and limit the flapping of the lung itself.¹

Discussion of anæsthesia and operative details will be omitted in this paper, as its purpose is to call attention to other matters. Thoracotomy has for its aim the *immediate, complete, and continued* drainage of the pleural cavity. This statement will be so generally accepted that it almost needs an apology for mentioning it. It is on the basis of free drainage alone that the great majority of empyemas in the past, the world over, have been treated, and usually with success in bringing the lung to the chest wall with final healing. There are failures, but omitting those due to retained foreign bodies, there seems little doubt that most of the failures result from insufficient drainage. The opening narrows down and becomes inadequate while an infected cavity remains. This may occur even with the drainage tube still in place, for free drainage around the tube becomes less as healing continues and the end of the tube may be closed at each expiration by the lung or diaphragm. In fact, the usual double-barrelled tube drain is chiefly useful in keeping the wound edges apart to permit drainage between and around rather than through the tubes.

At intervals there arise advocates of treatment based on two other principles: First, the antiseptic treatment of the cavity, and second, the suction method. The profession seems loath to abandon the suction principle and has displayed great ingenuity in devising apparatus with this end in view, and yet the problem of making a joint between human tissues and other materials that shall be air- or water-tight for any considerable period, seems as far as ever from solution. So soon as a suction apparatus fails to suck either from plugging of the tube or from failure of the joint to be air-tight, there may result, *first*, a pneumothorax with embarrassment of breathing; *second*, failure of drainage—the sine qua non of success; *third*, interference with the usual mechanism by which in the open chest the lung is brought back to the chest wall. Why does the elastic lung, once the chest has been open, ever expand to fill its place again? Conversation and reading lead one to the belief that there are many views on the subject. The matter is admittedly hazy in many minds. When the lung is said to expand to fill the space, one should not

¹ With the knowledge that the aspiration or aspiration and injection treatments cure some cases, there is growing up a tendency to continue the treatment too long. During the progress of a case under aspiration, the general condition may for a time very considerably improve. The patient seems not so sick and the temperature may remain only a little above normal. This, however, does not indicate necessarily that the patient is going on to recover without a thoracotomy. The more important guide would seem to be the rapidity of recurrence of exudate. If, with subsidence of the toxæmic symptoms there is not a rapid diminution in the amount and rate of formation of the exudate, one should abandon the idea of a cure by this method. If persisted in, the lung may become so fixed in the compressed position as to delay the obliteration of the cavity after thoracotomy.

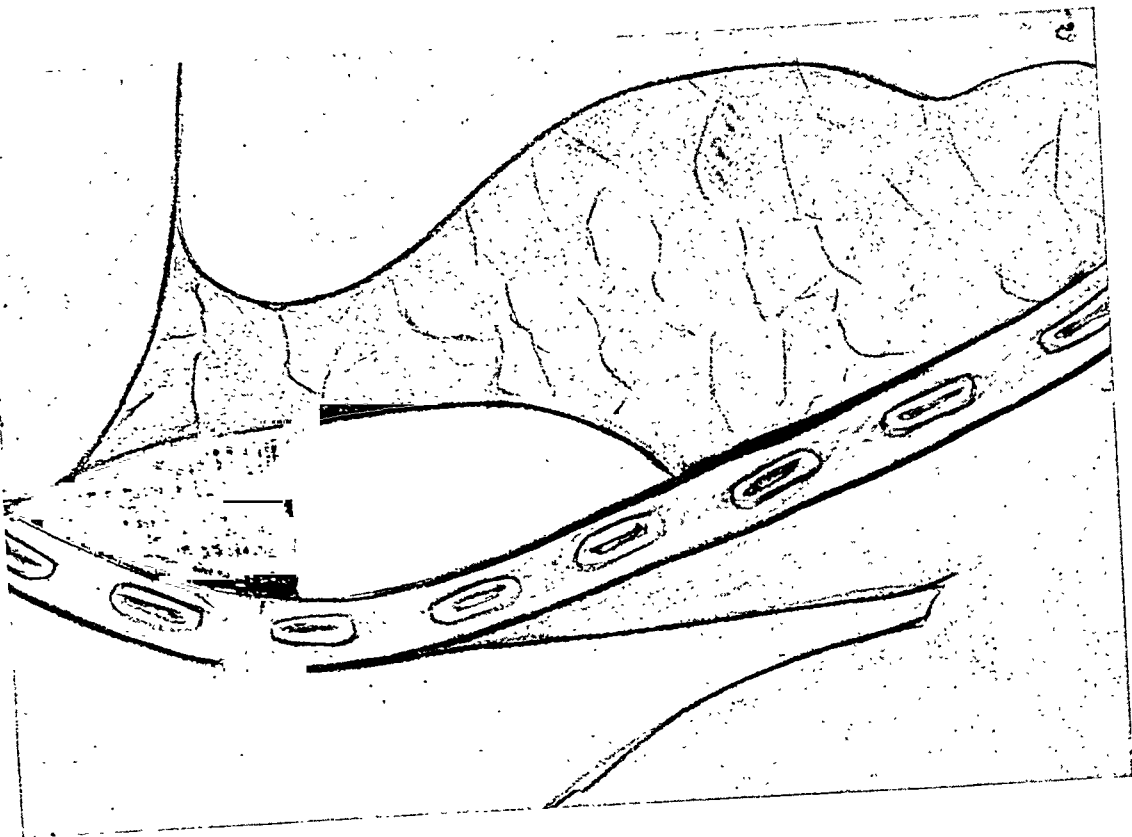


FIG. 1.—Small cavity partially filled with air and liquid after removal of drainage tube.

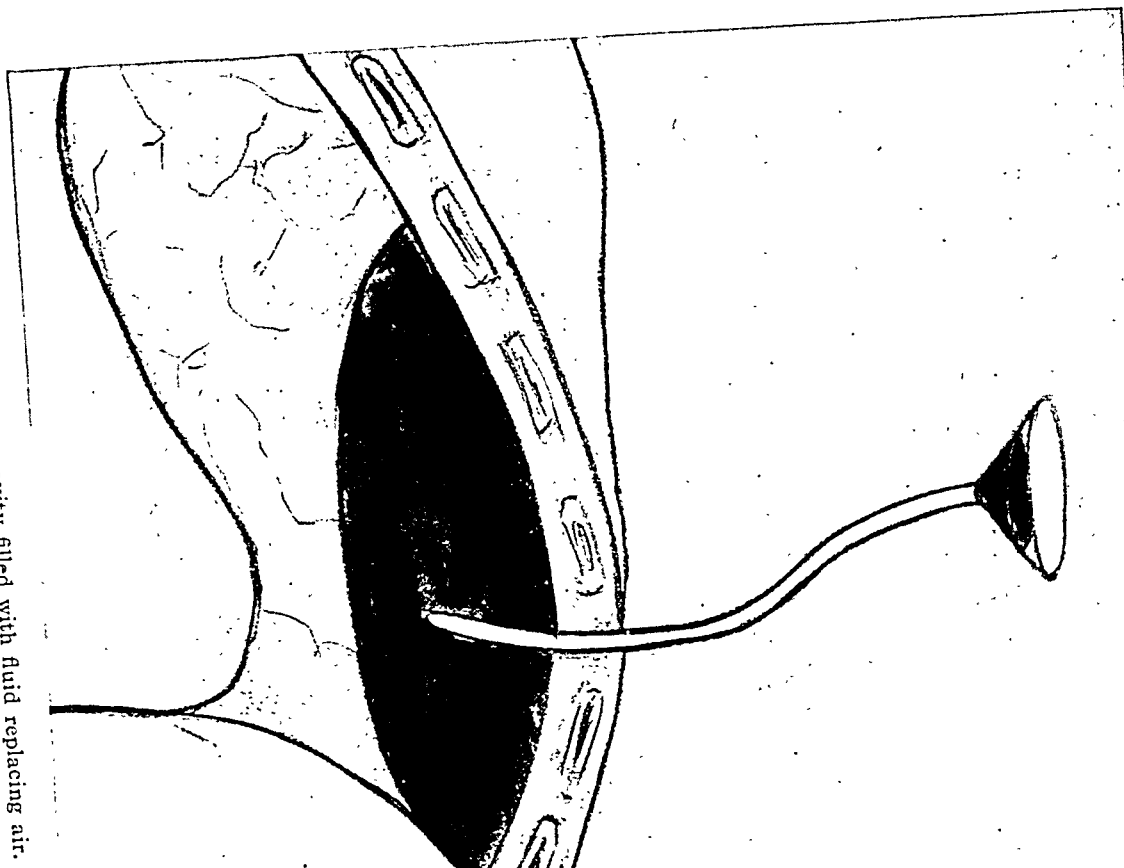


FIG. 2.—Patient on side; same cavity filled with fluid replacing air.

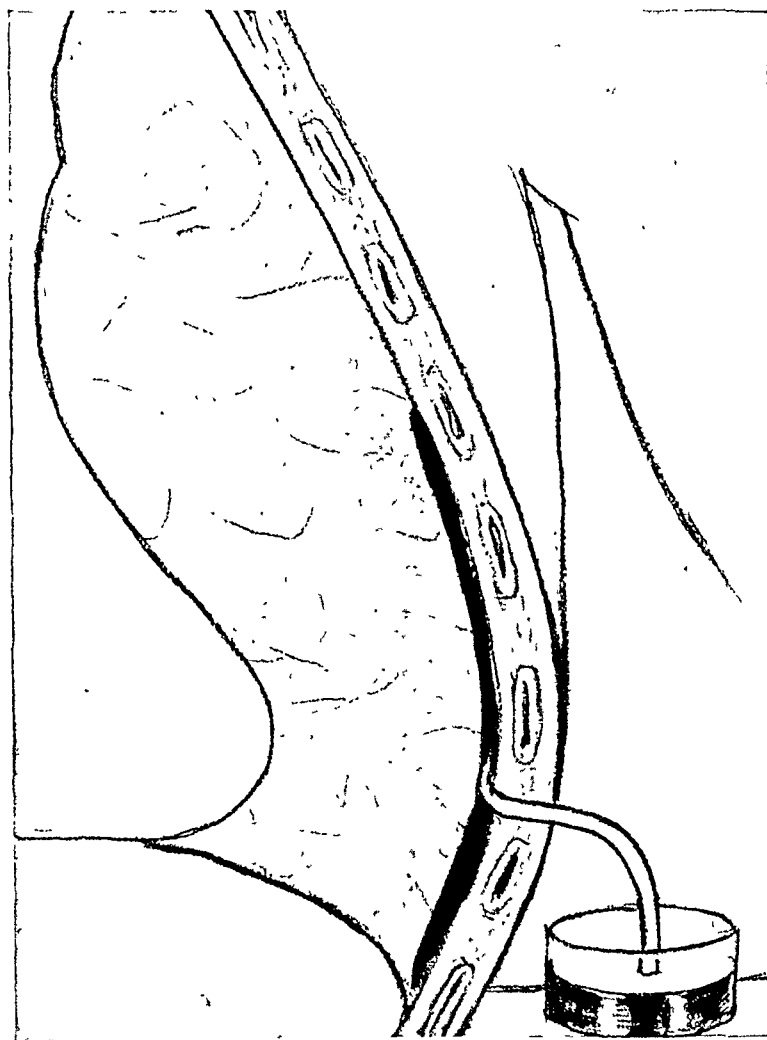


FIG. 3.—Catheter end under water. Fluid largely evacuated, bringing walls of cavity into apposition.

think of the lung as taking any active part in the process. The lung can only contract in virtue of its elastic fibres.

During quiet respiration in the unopened pleura there is a constant, varying, but always negative pressure. It rises roughly from about minus ten to minus two millimetres of mercury with each respiratory cycle. Intrapulmonary pressure, however, is alternately positive and negative even in quiet breathing. The amount of positive pressure required to make air escape through the unobstructed trachea is very little. Conditions are enormously different, however, in forced expiration. Here pressures as high as plus eighty millimetres of mercury have been recorded in the trachea and pleura and we have all witnessed demonstrations of the force of this positive pressure when, during a thoracotomy, the patient coughs and pus is driven to a distance from the wound.

I believe the positive pressure of forced expiration and coughing is the only efficient force expanding the collapsed lung and bringing it back to the chest wall. Adhesion of moist surfaces and fibrous adhesions may aid in holding the pleural surfaces in contact, but their agency is secondary. The lung, like a toy balloon, expands only when some one blows in it. Clinically, we observe that a large amount of expansion of the lung occurs during the operation itself, and physical signs show in favorable cases that in a day or two the lung nearly fills the chest. This has involved the stretching out of adhesions which in the recent case are fibrinous and give easily and are not comparable to the organized vascularized adhesions which might be encountered in a chronic empyema. This early expansion presupposes an easy exit from the pleura of both liquid and air and should make one cautious about the use of suction apparatus which, if it fails to suck, not alone fails in its purpose but inhibits the expansion of the lung by the old reliable method of intrapulmonary, positive pressure. A cushion of air in the pleura is to be strenuously avoided.

The expanding force of expiration acts but intermittently, and one may ask why the lung does not fall away between respirations and hence fail to bring about a permanent expansion. It has been urged that the expansion only can be maintained after the thoracic opening has become smaller than the chink of the glottis. If this were so, we should only expect late rather than early postoperative expansion of the lung, which is directly contrary to clinical observation. *The stabilizing of the lung's expansion is dependent on valve action at the thoracic wound and largely independent of its size.* If the exit of fluids is free and the entrance of fluids restricted, we have just the condition necessary to maintain lung expansion. For free exit of fluids—either air or pus—we need an adequate opening and the valve action is contributed by a dry—or better, a wet—dressing over the tube end or wound. Pus and air escape readily, but there can be no question that the pus-soaked dressing over the wound mouth offers a considerable amount of obstruction to the entrance of air to the pleural cavity. At a later stage, when tubes are removed,

an efficient valve action is supplied by the edges of the wound itself. These being in contact interfere with the drawing in of air even when pus may be discharging freely. I believe we will advance the interests of our patients if we keep steadily in mind that *valve* action at the wound is essential to healing and drop all efforts to replace it by any form of suction.

Our caution in the past has made us drain much longer than is necessary. We thought the cavity must heal down to a sinus to make the removal of the tube safe and we feared to irrigate, hence we were but vaguely informed as to the size of the cavity and whether it was real or potential, *i.e.*, a cavity with walls in contact.

In my cases, I have depended in the early days after operation on free drainage only and no irrigations, hoping to get the lung well up to the chest wall promptly as the result of the wide opening with valve action. In the removal of the drain, I am guided by disappearance of temperature and diminution of discharge and change of its character; and to a large extent by information gained by measuring the size of the cavity. The patient lies on the sound side and liquid is run into the cavity through a tube until the cavity is filled. The patient then sits up and the cavity is measured in this position. A cavity of several ounces capacity in the horizontal position may have its walls nearly in contact in the erect position. When the cavity will only hold a few ounces the tube is removed, after which, beside watching for a rise of temperature, one may proceed as follows: Insert a catheter daily to know whether the drainage is satisfactory. If pus is found in the pleura instead of on the dressing, the tube is returned. Should the return of a drain not be considered necessary, the patient is placed on his side, a catheter is inserted and the cavity filled with water to replace all air by gravity—never by forceful injection. Deep breathing by the patient will aid considerably. We now know the size of cavity in the recumbent position by the amount of fluid injected. Then with cavity full of liquid, with the catheter in place, put the outer end under water and let patient sit up and breathe deeply. At times a part and at times all the fluid escapes. If it does so in absence of air, the walls of the cavity must come into contact. The tube is then removed and dressing applied. The valve action of the end keeps air out, but the injected fluid—if some has remained in the cavity—gradually is expelled through the sinus and must bring the lung to the chest wall.

By the method outlined, we aim to shorten the time of healing by the early removal of the drainage tube and then keeping ourselves informed, first, as to whether drainage is continuing; second, as to the size of the cavity from day to day with patient in horizontal and upright position; third, by exclusion of all air and filling cavity with liquid we compel the lung to expand as fast as the liquid escapes from the sinus; and fourth, by thinning the discharge with our irrigating fluid, we favor its expulsion.

With those who wish to employ antiseptic methods in the treatment

of empyema, I have no quarrel unless they use a method which supplants drainage—as, for instance, when a measured quantity of pus is aspirated and replaced by the antiseptic, though such treatment is sometimes successful. However, it is indisputable that empyema can be quite satisfactorily treated without antiseptics and the question for each one to decide for himself is whether he can shorten the healing of the average case or keep some case from going on to the stage of chronic empyema by their use.

When I first heard of empyemas treated with Dakin's solution and then closed by suture in about ten days, I must admit to a considerable degree of interest and surprise. More recently the suture method seems to have been abandoned and I have come to the conclusion that the successful cases were of the type of empyemas that might possibly be cured by aspiration and that I have seen heal in two weeks by methods detailed above. However, there are incidental advantages from the use of Dakin's solution in empyema.

In employing fluid to measure a cavity and to replace air, Dakin's solution possesses the advantages that it is non-toxic, mildly antiseptic, and liquefies the pus and fibrin. There would seem to be less danger of mixed infection of the cavity under its usage than when a bland fluid like salt solution is employed. As I have employed it once a day to measure a terminal cavity and to replace air in it, it can hardly be credited with contributing much to the chemical sterilization of the cavity. It seems to me that the antiseptic treatment of a cavity would be most useful toward the termination of a case if there was reason to believe that the cavity was not cleaning up under drainage alone and that its size had reached a standstill. Even here, I should suspect that some mechanical fault was related to the delay in eliminating infection.

CONCLUSIONS

1. The percentage of recoveries in empyema will be increased by more frequent resort to aspiration.
2. A wide thoracotomy will not delay but hasten healing by favoring the early lung expansion.
3. Valve action at the wound is essential to healing.
4. Fear of irrigation of small cavities should be abandoned.
5. Delay in obliteration of a small cavity may depend on contained air.
6. Measurement of cavities from time to time is desirable as a measure of progress in treatment.
7. The walls of a cavity may be approximated by replacing air by liquid, on the escape of which the cavity is left empty, *i.e.*, with walls in contact.

Interest, experience, and painstaking are desirable at every stage in the management of empyema. Operation is a very small part of it.

CLINICALLY DOUBTFUL BREAST TUMORS: THEIR DIAGNOSIS AND TREATMENT

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IN 1894 the complete breast operation for cancer of the breast was described by Halsted¹ and a few weeks later by Willy Meyer.² This operation was based upon pathological studies regarding the local growth and methods of metastasis. Since that time much has been added in the way of study of the cellular pathology of cancers, the study of other tumors or lesions in the breast, and the development of operations for other conditions. There have been some modifications of the original operation for cancer as regards skin incision and order of the steps in the operation, but the principles are the same. There has always been a high mortality in cancer of the breast, not due to the lack of knowledge of surgical procedure in recognized cancer, but rather to the late or hopeless stage of the disease when the patient presented herself to the surgeon.

A few years ago, under the leadership of the American Medical Association, an educational campaign was inaugurated for the purpose of informing the public about the various breast diseases, and especially with the object of impressing upon them the necessity of early intervention if cures are to be expected. Already some clinics have been able to demonstrate by statistical studies that cancer is coming to operation much earlier in its course, that more benign tumors are being seen, and that many more cases of cure are recorded in cancer. In fact, the campaign has been so successful that we find ourselves confronted by an avalanche of tumors that are not clinically cancer according to our previous standards, and we are, as a profession, unprepared to take care of these cases intelligently because we are not sure as to the condition with which we are dealing. If, therefore, we are to keep pace with our education of the laity in regard to coming early for operation, we must seriously and definitely work out, if possible, a solution for the problem of diagnosis.

In our unprepared state we have reacted rather differently to these new conditions, and the type of reaction has been largely the result of individual or small group impressions. Very little has been done outside of a few larger clinics, in the way of actual scientific or practical study of the problem. The average man who attempts breast operations chooses one of three methods of dealing with the situation.

The first group, and the one that probably has studied the pathology and treatment more extensively than the others, has taken no chances

and has removed by complete operation all the tumors that are frankly cancer or doubtful clinically. They have not failed to cure the early cancers, but they have been compelled to do complete operations where after-studies showed that a local operation would have sufficed. This would not be a serious objection in many ways were it not for the fact that this wholesale removal of breasts has reacted on the patients, and not a few of them are willing to take their chances rather than suffer unnecessary mutilation.

The second group, the class that is more interested in immediate results and avoidance of mutilation, looks upon all doubtful tumors with suspicion and prefers not to do a complete operation in any case in which cancer has not been proven clinically. These individuals remove the breast alone or simply enucleate the tumor, send the material to the laboratory, and upon report of carcinoma, proceed with the radical operation. The surgeons in this group sacrifice no breasts unnecessarily, but fail to produce a permanent cure in practically every case of cancer which is doubtful clinically.

The third group, the almost totally unprepared class as far as knowledge of pathology and treatment of breast conditions is concerned, prefers to procrastinate till the symptomatology is plain and unmistakable, or they fall into the error of applying salves or escharotics, or equally meddlesome methods. Their methods and results are not far removed from those of the various charlatans. It is needless to say that they never obtain a permanent cure in cancer cases.

We are all agreed that the only way of properly treating a cancer of the breast is the complete removal in one block of the breast with all the primary lymph-vessels and lymph-glands which drain the breast.³ Experience has also shown that the incision through the skin and the subcutaneous tissues should not divide any of the lymph-vessels on their way from the breast to the primary lymph-nodes. This means that the treatment of cancer which gives the patient the highest number of chances of cure does not include any two-stage operation,⁴ and we are all agreed that the removal of the breast or the tumor and the subsequent removal of the pectoral muscles and axillary contents after the diagnosis has been made is highly improper and lessens the patient's chances to a marked degree. If this be true then we must not expose ourselves to two-stage operations, if our objective is first of all the patient's safety. On the other hand, if we are to avoid unnecessary mutilation we must find some means of arriving at a diagnosis in doubtful cases. It is appropriate to conclude, therefore, that the most important problem in breast lesions to-day is that of early and proper diagnosis and confirmation of this diagnosis before the patient leaves the operating table.

In the study of the literature and of our own cases, we are able to confirm the following facts in regard to the well-known clinical signs and symptoms of breast conditions.

Pain.—The presence or the absence of pain in a tumor of the breast taken alone means nothing (Table II). Very frequently, however, a benign tumor is painful and usually the pain with malignant tumors is a late development. A lump that is painful and tender only at periods we have found invariably to be benign and usually of an adenomatous variety; the degree of pain apparently depending upon the amount of parenchymatous elements composing the tumor. If the mass is cancer and painful there are usually present other signs which lead to a diagnosis of cancer. Early pain, therefore, while not an absolute sign of benignancy, might be taken as all but positive evidence against cancer in the absence of any signs of malignancy.

TABLE I

108	Benign	Malignant	Remarks
Total cases.....	38	70	Total number benign and malignant, 108.
25 under.....	3	0	Fibro-epithelial tumors.
Skin changes.....	2*	39	* Recent trauma with skin discoloration (1); lipoma with skin fixation.
Nipple changes....	1*	31	* Old trauma with deep buried contracted scar.

TABLE II

108	Benign		Malignant		Remarks
	Yes	No	Yes	No	
Pain.....	22	12	35	26	Nine malignant tumors without data and four benign without data.
Multiplicity.....	7	31	4	66	Eighteen per cent. benign showed multiplicity; five per cent. malignant showed multiplicity.
Glands.....	9	29	45	25	Twenty-three per cent. benign with glands; sixty-four per cent. malignant with glands.

Lump.—It is generally understood that benign tumors are encapsulated, while malignant tumors are not. The matter of encapsulation cannot be determined clinically, but there are degrees in the definiteness or the indefiniteness of the limits of the growths which aid in arriving at the diagnosis. Thus a benign tumor, while it may be bosselated or irregular on its outer surface, gives the sensation of being covered by a capsule and slips about under the palpating finger. On the other hand, a malignant tumor usually does not slip about freely under the palpating finger and does not give the sensation of being covered by a capsule, because in the majority of cases the adjacent structures are closely adherent to the outer surface of the tumor. Again, the relation of the tumor to the rest of the breast or the breast lobulus from which it arises is of considerable help in drawing a conclusion. A benign tumor of the fibro-epithelial type is seldom buried entirely in the breast tissue. This type of tumor has a tendency to grow away from the lobulus at times with a

rather narrow base of attachment. Malignant tumors and the various types of abnormal involution (chronic cystic mastitis, senile parenchymatous hypertrophy) nearly every time are buried in or involve the body or substance of the lobulus. Involvement of a quadrant of the breast, that is, the involvement of all of one, or of more than one lobulus invariably means abnormal involution and not cancer. This is not a positive point, however, because cancer may develop in the midst of and be obscured by an abnormal involutional process.

Multiplicity.—Cancer at the onset nearly always is single, while benign tumors are frequently multiple from the beginning (Table II). Multiplicity is never a positive sign of benignancy, but in the presence of tumors of doubtful nature with strong benign characteristics it might be considered as confirmatory evidence that the tumors are benign.

Age.—The chance of malignancy in any tumor of the breast, regardless of the clinical signs, in a woman under twenty-five years is very remote. Bloodgood had one case in 885 malignant tumors.⁵ Age, therefore, may be taken as a positive factor when the patient is under twenty-five and when the clinical picture favors benignancy (Table I).

Nipple Changes.—Congenital retraction of one or of both nipples or acquired bilateral retraction is of no special diagnostic significance. Unilateral acquired retraction should be considered as diagnostic of malignancy if associated with a tumor mass⁶ (Table I). Apparently there are occasional exceptions to this rule, as, for example, severe injury to the breast with a deeply buried scar will sometimes result in nipple retraction due possibly to the contracture of the scar. This condition, however, is so extremely rare that it does not disprove the rule, that unilateral acquired retraction of the nipple means malignancy.

Skin or Fat Changes.—No benign condition ever causes true atrophy of fat with shortening of the trabeculæ or any of the other more advanced skin or subcutaneous changes such as dimpling or œdema.

(Occasional exception, see Table I and J. C. B. Bibliography No. 7. These exceptions are easily recognized, however, and do not disprove the rule.)

Therefore, any dimpling, œdema or discoloration associated with a tumor should mean malignancy (Table I).

Glands.—The presence or the absence of axillary glands is of very little diagnostic significance (Table II). If the condition in the glands is malignant the tumor in the breast is invariably either cancer or extremely doubtful, and the diagnosis is arrived at without taking into consideration the glands. Furthermore, the enlargement of the glands is quite a constant finding in abnormal involution. The time of the appearance of the enlarged glands in the course of the development of the breast tumor oftentimes is of some diagnostic significance. In cancer gland involvement is one of the late signs, while in inflammatory condi-

tions or abnormal involution the glandular enlargement follows close on the appearance of the breast lesion.

In summary, therefore, we find that we are in agreement with Bloodgood in that the clinical studies enable us to arrive at a positive diagnosis only in cases where there are skin changes or in cases of acquired unilateral retraction of the nipple, or in cases of a lump in the breast of women under twenty-five.⁸ It is a well-known fact, however, that a large majority of breast tumors are "clinically doubtful" and the diagnosis must be arrived at by some means other than clinical studies. Our only help outside of the clinical pictures comes from pathological studies, and if the diagnosis is to be made before the patient leaves the operating table, these studies must be done at the operating table.

If the solution of this problem is the study of the pathology of breast lesions at the operating table, then every surgeon that operates upon the breast should be familiar with the gross and microscopic pathology or should have always at his command at the operating table a pathologist for immediate gross or frozen-section diagnosis.⁹

The study of the pathology of breast tumors at the operating table is best brought about by the means of an exploratory incision. In the opinion of various contributors one has a choice of three proceedings, namely: (1) Enucleation of the breast gland, (2) excision of the tumor with a narrow zone of breast tissue, and (3) exploratory cutting down onto or into the tumor before removal. The first procedure is time consuming and divides every primary lymph-vessel from the tumor to the skin, to the axilla and to the mediastinum. All authorities are agreed that this is an extremely dangerous procedure and should not be practiced.

The second method, that is, excision of the tumor with a zone of breast, does not involve the division of all of the skin lymphatics but does mean cutting across every other lymphatic from the tumor. It is argued that the interval between the division of the lymphatics about the tumor and the accompanying dissemination is so brief that the cancer cells do not have time to travel beyond the limits accessible to the knife in the complete dissection. This may be true, but in view of the fact that we have no lymph-glands as filters and relay stations between the tumor in the breast and the inaccessible glands beneath the sternum, it would seem that one were taking considerable chances. While this method has not the objections of the first, still its objections are too numerous.

The third procedure and the one advocated by Bloodgood¹⁰ is the cutting down by radial incision directly upon the tumor, and as soon as the diagnosis is made or the necessary piece taken, the whole wound and tumor are thoroughly carbolyzed. After a few trials and a thorough study of each case, one can make a diagnosis from the gross appearance alone in a very high percentage of the cases. In these instances one has almost entirely avoided dissemination because the carbolic is applied immediately after the incision with a resulting immediate and complete coagulation.

DOUBTFUL BREAST TUMORS

The incision is made directly over the tumor and lies in the radius of a circle of which the nipple is the centre. Hemorrhage is very carefully controlled to prevent staining or discoloration of the tissues. It is very necessary that the wound be kept dry because the diagnosis rests upon the appearance of the tumor and practically not at all upon its consistency, etc. While the lump is held very firmly between the fingers the cut is made directly down upon it (Fig. 1). If the lump is not held firmly between the fingers, the knife is very likely to miss the tumor, especially if it is small. This point we have seen illustrated in one recent case. As the tumor is approached the behavior and condition of the aureolar and breast tissue is very carefully observed. If a bluish color is seen, the diagnosis of a cyst is made. The finding of a blue tumor is always considered evidence of benignancy. The cyst is laid open and the incision is carried beyond the cyst completely through the breast lobulus. This is done because the presence of a cyst very often means abnormal involution and there may be other changes in the breast about the cyst. If evidence of abnormal involution is discovered, other incisions are made lateralward in the breast tissue for the purpose of determining, if possible, the extent of the change.

(In one recent case with large multilocular and adjacent cysts containing clear fluid, some fragments of friable threadlike papilloma were found, and a cancer was discovered in the wall of cyst only by carefully cutting into all the cysts. One cyst proved to be solid and to be cancer.)

If no bluish color is seen, the next point for determination is the presence or the absence of encapsulation. The condition of encapsulation is demonstrated, of course, by the presence of a capsule or sheath entirely surrounding the tumor. This means that the surrounding connective tissue is not adherent to the tumor; accordingly as the aureolar tissue or the breast tissue is divided over the tumor under tension, the cut edges retract and the tumor has a tendency to suddenly pop into view (Fig. 2). This phenomenon is in marked contrast to that observed in cancer, where one usually finds that he is into the tumor while he is still looking for it. In cancer the growth is infiltrating and there is no capsule, therefore, the tissue immediately adjacent to the tumor is firmly adherent at all points. Because of this fact, the tissue over the tumor cannot be retracted under tension (Fig. 3). If the tumor fails to show the phenomenon associated with encapsulation, then a conclusion of malignancy is arrived at and the complete operation is immediately done. It is true that not all definitely localized masses in the breast which fail to show encapsulation are cancer, but the group is so small and at best the tumor is doubtful and deserves to be treated as cancer.

If an encapsulated tumor is discovered the mass is divided from end to end and the edge and the cut surface closely examined. This is done because some malignant tumors, that is, sarcomata and certain types of

cancer, developing from cystadenomata or arising from a papilloma in a cyst, may retain for some time a rather distinct capsule. Furthermore, when invasion beyond the rather sharply defined limits begins to take place, it is usually not an infiltration involving the whole surface, and

TABLE III

No. of cases	Clinical impression	Operative diagnosis	Pathological diagnosis	Remarks
26	Benign	Benign	Benign	Explored because local operation was planned. In one case found several smaller tumors and whole gland removed. This saved patient subsequent operations.
2	Benign	Benign	Malignant	Tumors encapsulated and granular. Incomplete operation followed by complete. Mistakes made early in study of exploratory diagnosis.
2	Benign	Malignant	Malignant	Two lives saved by exploratory.
4	Benign	.....	Benign	Diagnosis not attempted at operation and not known until pathological report.
4	Benign	.....	Malignant	Two-stage operation after pathological report was made from permanent sections. Patients probably dead.
3	Malignant	Benign	Benign	Three breasts saved by exploratory; retracted nipple from old scar (1), recent trauma with skin discoloration (1), lipoma (1). See Table IV.
11	Malignant	Malignant	Malignant	Proceed with complete operation with a certain diagnosis.
3	Malignant	.....	Benign	Three breasts sacrificed unnecessarily.
53	Malignant	.....	Malignant	Forty-three with skin or nipple changes, ten without skin or nipple changes.

TABLE IV *

Type of cases	No.	Remarks
Clinically benign (under 25)	2	Both bilateral.
Clinically malignant (skin or nipple changes).....	49	Nine were explored in spite of evidence. Three proved to be benign; these were recent trauma with skin discoloration (1), lipoma with skin fixation (1), retraction of nipple following deep hæmatoma eight months before (1).
Clinically doubtful.....	57	Thirty-two were explored. Seventeen were extremely doubtful, and diagnosis had to be made at exploratory. By exploratory three breasts were saved and two lives were saved. In the remaining eleven malignant cases we might have yielded to temptation of incomplete surgery had we not been able to make diagnosis at operating table.

* Based on study of 108 cases on which complete data could be obtained.

the original cut may expose only a portion of the circumference that does not show the infiltration.

If the borders of the tumor are quite sharply marked off from the surrounding tissues, and there is no indication at any point of infiltration,

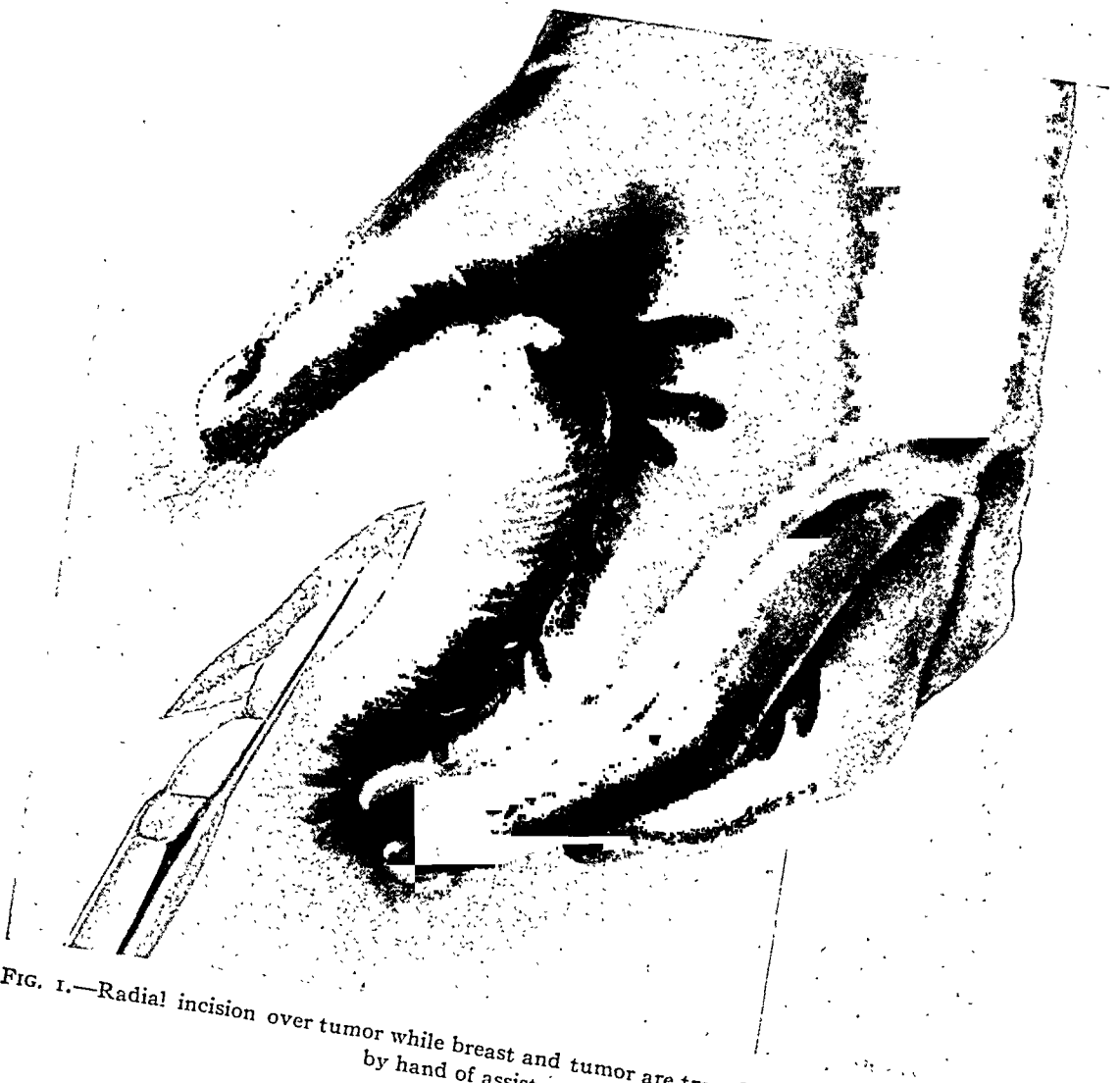
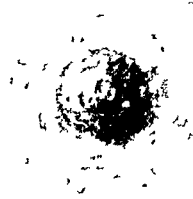
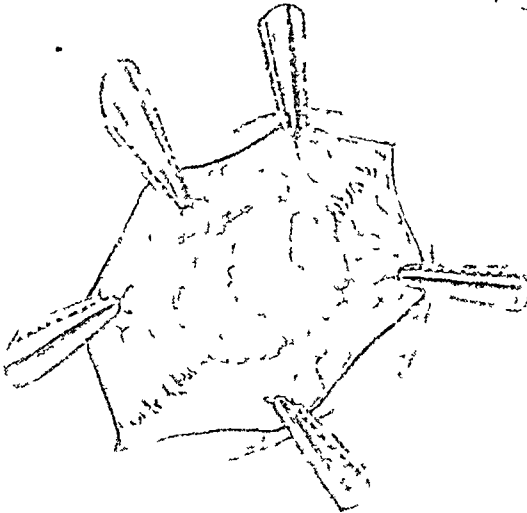


FIG. 1.—Radial incision over tumor while breast and tumor are transfixed by free hand or by hand of assistant.



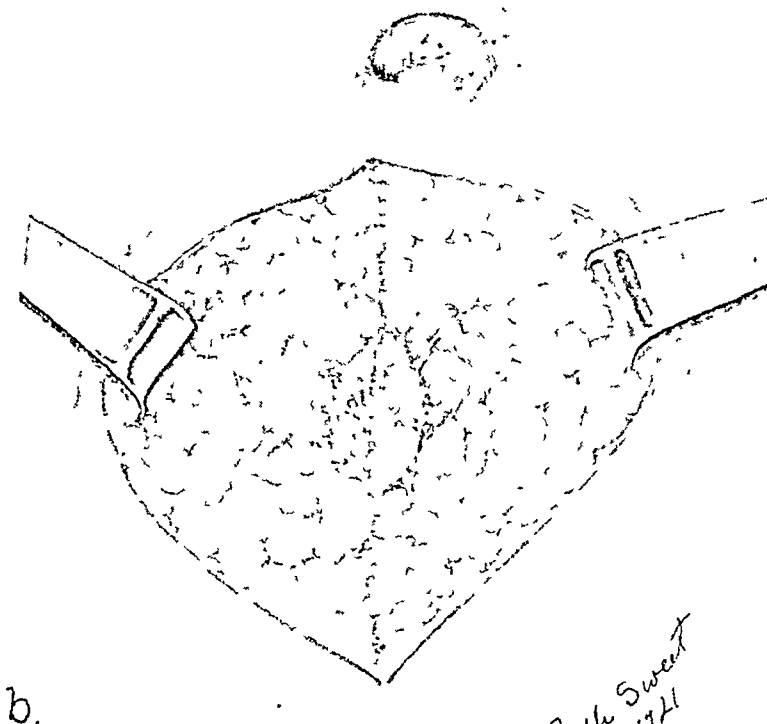
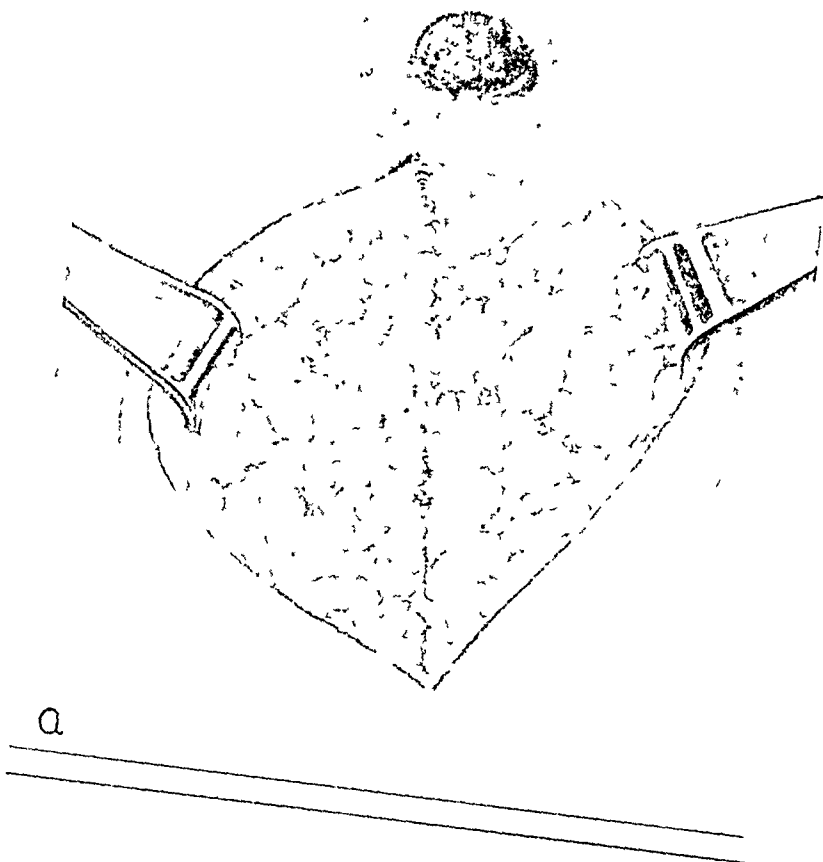
a.



b.

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FIG 2 —a, Radial incision through skin and alveolar tissue over encapsulated (benign) tumor. As tumor is approached, aureolar tissue retracts, showing dome of tumor, b, same as a with more of tumor exposed. Aureolar tissues retracts because it is not adherent to tumor except by blood-vessels



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FIG. 3.—a, radial incision over malignant or non-encapsulated infiltrating tumor. Skin and areolar tissue have been divided. With the palpating finger the tumor can be felt in depth of cut. There is no areolar tissue over tumor yet tumor cannot be seen, b, incision a little farther cuts into the tumor. Infiltrating character is evident at a glance. Close scrutiny shows connective-tissue markings and pin-point necrosis.



FIG. 4.—Showing bulging of cut surface beyond capsule. On palpation the surface of tumor was rubbery and shiny. The surface was not granular, and no tissue could be scrapped away on the edge of the knife.

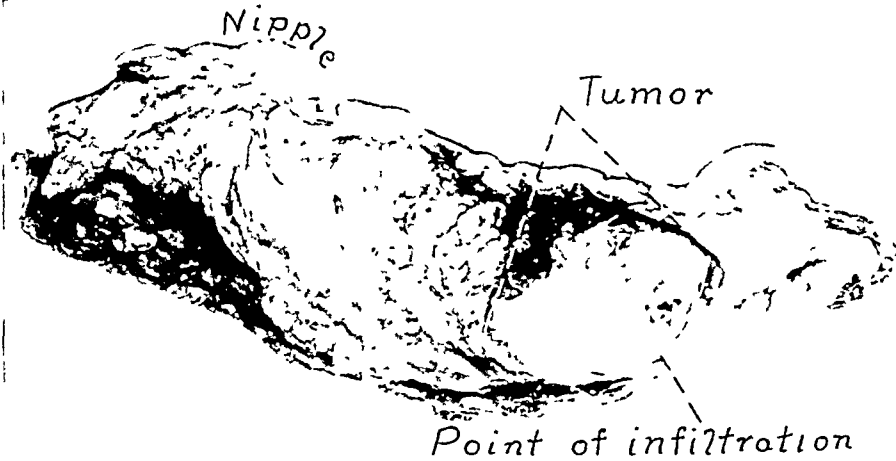


FIG. 5.—An encapsulated malignant tumor. Infiltration through capsule seen at lower right-hand border. Cheesy plugs can be seen. The surface was quite yellow and showed massive degeneration. The dark area at upper left-hand corner of tumor is blood-stained tissue from exploratory operation. Tumor from woman twenty-five years old, married, one child one year old.

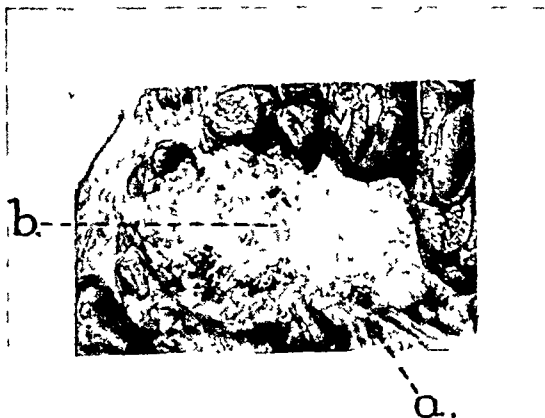


FIG. 6.—The cut surface of a malignant infiltrating tumor showing total lack of encapsulation and tendency for surrounding tissue to bulge beyond the tumor instead of the tumor to bulge beyond the capsule, *a*, infiltration of connective-tissue, *b*, points of necrosis.

then the cut surface must be relied upon for the final proof of the character of the tumor. In a benign tumor the cut surface is rubbery and has a tendency to bulge beyond the cut edge of the capsule (Fig. 4). In a malignant tumor the tendency for the tumor substance to bulge beyond the capsule is very faintly shown or is not demonstrable (Fig. 6). In addition the surface is practically always granular, sometimes quite degenerated, and very often some of the tumor substance can be easily scraped away.

If the diagnosis cannot be determined by the above procedure, then the investigation of the microscopic picture is resorted to. The study of the microscopic pathology is a field so large as to well deserve the whole attention in a separate paper, and the interpretation of microscopic pictures is a field limited to those who have given considerable time and study to micropathology. The services of a well-trained surgical pathologist are invaluable, but such experts are not numerous even in the larger centres. The poorly trained pathologist very likely will be doubtful about or will misinterpret lesions whose nature is obvious in the gross to the surgeon who has carefully observed his gross pictures. The greatest possible effort, therefore, must be made on the part of the surgeon to perfect his gross diagnosis and the number of cases for microscopic diagnosis must be small.

By these studies and careful observation of our cases, we are able to arrive at a positive diagnosis in practically all of the clinically doubtful cases. There remains only a small group of abnormal involutional conditions or rare tumors which may not be differentiated from cancer. This doubtful group we are compelled to treat as cancer. Comparatively speaking, this group is insignificant.

Treatment.—The discovery at exploration of a blue cyst without surrounding changes in the breast is treated by simple local removal of the cyst with a narrow zone of breast tissue. If the lateral incisions disclose further cystic involvement of the surrounding breast tissues, then a wider zone of breast is taken. If there seems to be an extensive involvement the whole gland is removed.

The finding at the exploratory operation of a benign fibro-epithelial tumor usually means that the tumor is removed locally with a narrow zone of breast tissue as in a simple cyst. If the tumors are multiple, the whole breast is sometimes taken in women who have passed the stage of lactation. In all other instances of multiple or single tumors the gland is preserved even at the expense of several incisions at one sitting or subsequent operations. The Warren type of procedure is used to advantage in some cases of multiple tumors after the diagnosis has been confirmed.

Summary.—Laying aside all other considerations and confining one's self solely to the problem of giving the patient the greatest number of chances of cure in malignant conditions, one must take into consideration not necessarily all but rather a certain few clinical signs and symptoms,

and one must do the complete operation or explore in every doubtful case.

The exploration should be done without delay. The breast should not be removed and an interval allowed to elapse between the time of removal and the pathologist's report. One should not remove the breast or the tumor for the purpose of immediate or subsequent pathological study.

One should cut down upon the tumor and should be sufficiently schooled in gross pathology to be able to make the diagnosis at a glance. Thorough coagulation with pure carbolic should be done immediately after the incision of a malignant tumor and then the complete dissection should proceed without delay.

No incomplete operation for tumor of the breast should be attempted in the absence of facilities for immediate diagnosis, and the diagnosis must be confirmed in every case before the patient leaves the operating table.

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CULTURES FROM THE APPENDIX

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THE problem studied in this paper is the infectiousness of the appendix. It is well known in a general way that the appendix is an infected organ, and that from it arise infections of the peritoneum and its contained organs and of the abdominal parietes during operative procedures.

This paper does not deal with the etiology of appendicitis, but with the bacterial content of the exterior of the appendix, and the meso-appendix, with its blood-vessels and lymphatics. It may be and probably is true that the organisms so isolated play a large rôle in the etiology of appendicitis, but the problem at hand was to determine the potential threat of the appendix to the peritoneum, its viscera, and the abdominal wall.

For the purposes of this study a consecutive series of appendices was chosen, including both chronic and acute cases but excluding all cases of perforation and of gross peritoneal infection. All of these cases were operated upon by me in the service of Dr. Charles L. Gibson at the New York Hospital, First Surgical, or Cornell Division. Cases showing perforation or peritoneal involvement were excluded because the true infecting organism is so quickly overgrown in such instances by colon and other hardier bacteria.

The technic followed was division of the crushed base of the appendix between clamps, with the cautery. Two small Kocher clamps are used, set as closely together as possible and well clamped. They are then rolled apart about one-quarter inch, leaving only a thin ribbon of peritoneum and muscularis to cauterize. In this way gross contamination of the field is fairly well provided against. The meso is divided before or after this step, according to convenience, and the appendix with the removed meso is at once dipped entirely beneath the surface of a broth culture tube, shaken gently, and removed. The cultures were then incubated and studied in the usual manner. No anaërobic studies were made. I am greatly indebted to Dr. George Wheeler, bacteriologist to the hospital, for his unfailing courtesy and friendly interest in the work.

The number and variety of infecting organisms may be noted in the accompanying chart. Conclusions must not be drawn from such a limited series of cases as to the etiology of appendicitis, nor the relative frequency of the various types of bacteria in and about the appendix. It does show, however, that the appendix is a contaminated organ, even

when there is not the slightest sign of acute infection, and that with the most careful technic, infection of the peritoneum and the abdominal parietes may ensue. Only the marked resistance of normal tissues to bacterial invasion prevents more frequent post-operative mishaps.

The subjoined table of 131 consecutive cases shows the colon bacillus, alone or with other organisms, in 57 per cent. of the appendices. Of the 45 acute cases the colon bacillus, alone or mixed, is present in 53 per cent. No other single bacterium appears in any large number of cases. Eighteen appendices gave no cultural growth. The two infected wounds of 36 acute cases closed without drainage (giving 5.5 per cent. infections); each showed the colon bacillus.

Of the 131 cases, 113, or 86 per cent., gave some form of growth; 122 were closed without drainage. Primary union was obtained in 117 (96 per cent.). Two hæmatomas, both sterile, appeared; one in a chronic appendix case, the other in a prophylactic appendectomy. One abscess of the parietes appeared in a prophylactic appendectomy. The culture showed staphylococcus albus, probably a skin contamination. Two of the acute cases developed a parietal abscess on the seventh post-operative day.

CONCLUSIONS

The appendix is potentially an infecting agent even when the most careful technic is used. Too much care cannot be exercised in delivering and removing it. Occasional parietal and deep-seated infections will occur under the most approved technic.

My most grateful thanks are due to Doctor Gibson for the privilege of operating upon and reporting these cases and to Doctor Wieden of the House Staff for aid in preparing the data.

CULTURES FROM THE APPENDIX

Dr. Chas. E. Parr 131 Cases		
Chronic appendix. Primary union.....	17	Gram neg. bacillus of colon group
Chronic appendix. Hematoma of wound..	1	Same + Gram positive cocci
Prophylactic appendectomy. Primary union.....	14	Same + diphtheroid bacillus
Prophylactic appendectomy. Hematoma of wound or abscess of wound.....	..	Same + staphylococcus albus
Acute appendix. Primary union.....	13	Same + staphylococcus aureus
Acute appendix. Drained wounds.....	3	Same + non-hemolytic streptococcus
Acute appendix. Seventh-day infections...	2	Bacillus coli communis
Total.....	50	Same + staphylococcus aureus bac. proteus
	1	Same + bac. lactis aërogenes
	2	Same + staphylococcus albus
	1	Bacillus coli communior
	11	Staphylococcus aureus
	1	Same + non-hemolytic streptococcus
	1	Diphtheroid bacillus
	4	Bacillus pyocyaneus
	4	Staphylococcus albus
	1	Same + diphtheroid bacillus
	1	Gram neg. bacillus producing no gas and fermenting no sugar (contaminated)
	4	Bacillus alkaligines
	3	Bacillus proteus
	4	Contaminated with bacillus subtilis
	2	Contaminated
	18	No growth
	131	Total

RESULTS OF TREATMENT OF TWENTY RECENT CASES OF INTRACAPSULAR FRACTURE OF THE FEMUR BY ABDUCTION AND PLASTER FIXATION*

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AND

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IN THIS statistical report we have included all cases regardless of previous treatment. One case had been treated four weeks by the Buck's extension treatment before we placed her in a cast, but, nevertheless, we include it in this report. No case was considered too ill for this form of treatment, as is evidenced by two cases. One had cardiorenal disease and was too ill for an anæsthetic. A cast was applied and the patient died five days later of a broncho-pneumonia. The other case was a patient of eighty years, who at the time of admission was in a semiconscious condition; a cast was applied and she died five days later of hypostatic pneumonia. These are the only two cases that died out of the twenty treated by our method.

The age of the patients treated is a very important point to consider. One patient of thirty-seven and another of fifty years are the youngest we have on our list, the other eighteen ranging from sixty to eighty years of age.

The condition of these patients on admission to the hospital in most cases was such that it would make one stop to wonder if any form of treatment would be helpful to them, yet all cases were treated. Five of these patients had incontinence of urine and fæces on admission, and four of them recovered from this condition after application of the cast; one in nine days, another in seven days, and two in five days. Six had decubitus on admission, and after application of the cast and local treatment two of them were cured in four days, two in eight days, one in ten days, and one in twelve days. No cases of decubitus developed while in the cast, because of the ease with which these patients can be handled. The same may be said of lung complications, for the patient can be placed in a wheeling chair without any difficulty.

On admission it was impossible to move the patients without causing pain and shock. They refused nourishment, were depressed, and continually complained, but after application of the cast there seemed to be a marked change. They became cheerful, very easy to lift, quite sociable and showed a marked improvement in appetite. Instead of developing

* Read before the Philadelphia Academy of Surgery, February 7, 1921.

decubitus, that already formed showed marked improvement. It has never been necessary to remove a cast because of any complaints from the patient. Two patients had umbilical herniæ, and three had inguinal herniæ, but they suffered no inconvenience from the cast.

One of the most interesting points brought out in this tabulation of cases is the X-ray report of pictures taken of the fracture after removal of the cast. All but two showed a dense fibrous union, although, clinically, all but one seems to have permanent osseous union. The two cases which show osseous union are the two youngest on the list—the one of fifty years and the other of thirty-seven. Another point of interest to be noted is that of the twenty cases, eighteen are females. We have no explanation to offer, excepting that the female pelvis is slightly broader and that the bones of the female are slighter than the male.

The final results of these cases show that nine have full function restored, eight cases have slight impairment of function, but all are capable of walking about. Five use a cane. One case has complete absorption of the neck of the femur and a shortening of two and three-quarters inches and requires an elevation of the sole of her shoe which enables her to walk with the aid of a cane.

We do not expect osseous union in any case over sixty-five years of age, but good functional results are to be obtained.

Any statistical review of intracapsular fracture without a detailed history of each case is difficult to analyze, for we know that many of our cases were very unfavorable subjects for any form of treatment. We are satisfied with the results obtained in these cases and feel that any patient who has not obtained a good result would have had less chance with bone-plating, pegging, and the other forms of treatment.

It is to be noted that we are discussing recent cases and not old ununited fractures with absorption.

MURPHY AND DORRANCE

No.	Patient	Age	Sex	Date of admission	Date of discharge	Shortening on admission	Number of days before application of cast	Length of time cast remained on patient	Incontinence of urine and feces after application of cast	Bed-sores	Union as shown by X-ray	Position as shown by X-ray	Amount of shortening after removal of cast
1	A. F.....	80	F	1/20/16	3/ 2/16	1 1/2 inches	7 days	13 weeks	9 days	None	Dense fibrous	Fair	1 inch
2	C. M.....	75	F	1/23/16	4/19/16	1 inch	4 days	13 weeks	.....	8 days	Fibrous	Fair	3/4 inch
3	M. McG..	73	F	12/16/15	4/10/16	1 1/4 inches	3 days	13 weeks	.....	.....	Fibrous	Fair	1/2 inch
4	M. C.....	65	F	12/15/15	4/ 5/16	1 inch	2 days	13 weeks	.....	.....	Fibrous	Fair	1/2 inch
5	E. D.....	64	F	2/24/16	4/10/16	3/4 inch	2 days	13 weeks	.....	4 days	Dense fibrous	Fair	1/2 inch
6	A. D.....	71	F	12/30/19	5/ 1/20	1 1/2 inches	3 days	13 weeks	5 days	8 days	Fibrous	Fair	1/2 inch
7	A. D.....	60	F	3/30/20	7/ 9/20	1 inch	2 days	13 weeks	.....	.....	Fibrous	Good	3/4 inch
8	L. M.....	69	F	10/16/19	3/25/20	3 inches	3 days	14 weeks	.....	.....	Fibrous	Good	2 3/4 inches
9	C. McC...	50	F	1/10/20	4/18/20	1 inch	3 days	13 weeks	.....	.....	Osseous	Good	.....
10	A. S.....	65	F	11/10/20	Still in hospital	1 1/2 inches	4 days	17 weeks	5 days	10 days	Dense fibrous	Fair	3/4 inch
11	J. T.....	37	M	2/10/20	5/30/20	1 1/4 inches	3 days	13 weeks	.....	.....	Osseous	Good	1/4 inch
12	M. D.....	70	F	12/25/19	Died	1 1/2 inches	.....	.....	.....	.....	.....	.....	.....
13	M. M.....	70	F	1/ 9/16	12/31/19	1 1/2 inches	4 days	13 weeks	7 days	12 days	Dense fibrous	Fair	1 inch
14	A. A.....	80	F	4/23/17	4/18/16	1 1/4 inches	2 days	.....	5 days	.....	.....	.....	.....
15	M. B.....	76	F	10/13/17	4/28/17	1 inch	4 weeks	10 weeks	.....	.....	Fibrous	Fair	1/2 inch
16	J. M.....	70	F	3/ 1/15	2/12/18	1 inch	4 days	12 weeks	.....	.....	Fibrous	Good	1/2 inch
17	L. F.....	64	F	8/29/17	6/18/15	1 inch	7 days	13 weeks	.....	4 days	Fibrous	Good	1/4 inch
18	S. F.....	60	F	2/ 2/17	12/24/17	3/4 inch	2 days	13 weeks	.....	.....	Fibrous	Good	.....
19	S. M. G...	62	F	12/21/17	5/ 5/17	1 inch	3 days	13 weeks	.....	.....	Fibrous	.....	1/4 inch
20	W. G.....	77	M	8/29/17	3/ 1/18	1 inch	4 days	13 weeks	.....	.....	Fibrous	Good	1/2 inch

Results

- No. 1. Patient walks, function good.
 No. 2. Patient walks, slight limp.
 No. 3. Patient walks, full function.
 No. 4. Patient walks, slight limp.
 No. 5. Patient walks, slight limp.
 No. 6. Patient walks with limp.
 No. 7. Excellent, full function.
 No. 8. Absorption of neck of femur, requires a built-up shoe.
 No. 9. Excellent, full function.
 No. 10. Up to present time, excellent.
- No. 11. Excellent, full function.
 No. 12. Died of pneumonia (cardio-renal disease).
 No. 13. Patient walks with limp.
 No. 14. Patient died of pneumonia.
 No. 15. Slight limp, walks with a cane.
 No. 16. Full function.
 No. 17. Full function.
 No. 18. Full function.
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CANCER OF THE LARGE INTESTINE *

NOT INCLUDING THE RECTUM AND RECTOSIGMOID

BY JAMES I. RUSSELL, M.D.
OF NEW YORK, N. Y.

IN reviewing the cancerous growths of the large intestine, not including the rectum and rectosigmoid, occurring in the Surgical Service at the Roosevelt Hospital during the past six years—1915 to 1920 inclusive—there were forty-seven cases admitted into the service, forty-two of whom were operated; the other five either declined operation or were considered inoperable for various reasons: debility, cachexia and so forth, with non-obstructive conditions at the time of examination.

During this same period there were 17,527 operations performed, fifty-five of which were for cancer of the rectum and rectosigmoid, which are not included in this report but confirm the fact, though the series is a small one, that carcinoma of the rectum and rectosigmoid is much more frequent than in the entire large intestine from the ileocecal valve to the rectosigmoid juncture. As with cancer appearing in other parts of the human body, cancer of the big gut is a condition of later life, though it may occur at almost any age; our oldest patient being seventy-eight years, the youngest twenty-one years. The former was suffering from acute ileus at the time of his admission into the hospital, his condition was extremely grave, an immediate enterostomy was done, followed by death four hours later. The youngest, a woman of twenty-one years, had a perforated carcinoma of the cæcum with extensive peritonitis at the time of admission; abdominal and vaginal drainage were immediately instituted, at which time the cause of the peritonitis was undetermined. A second operation a few days later disclosed a perforated cancer of the cæcum. She died eight days after the first operation.

Cancer of the large intestine was about equally common in the two sexes, there being twenty-four men and twenty-three women. The first signals in the great majority were of gradual onset of which the most frequent were pain and constipation. The onset, however, may be of an alarmingly short duration; two days is our shortest time and two years our longest. The average duration of symptoms until admission into the hospital was about six months.

Given the age of the patient and a carefully elicited history, with undivided attention to the symptoms and the sequence in which they appear, aided by a careful physical examination and the X-ray findings, it would seem that a correct diagnosis should be reached at a much earlier time. Yet, on the other hand, we know that a cancerous growth, and

* Read before the New York Surgical Society, April 27, 1921.

especially in the cæcum where the obstructive symptoms may be long delayed, can reach a considerable size and not infrequently be observed by the patient before the surgeon is even consulted.

It is commonly pain; more or less persistent, but usually recurring in attacks with increasing frequency, constipation becoming more aggravated (only relieved by catharsis, and this in increasing doses and strength), blood in the stools, or possibly a mass discovered by the patient himself, that prompts the patient to seek advice for relief of his condition. Pain was the most frequent symptom complained of in thirty-six of our cases; constipation, varying from mild constipation to complete obstipation, the next most prominent symptom in thirty of them. Distention, vomiting, loss of strength and loss of weight occurred with about equal frequency in seventeen of them. Hemorrhage from the bowel observed by the patient occurred in one-fourth of the forty-seven cases, *i.e.*, twelve complained of this symptom. Five complained of diarrhœa and two of epigastric distress.

Tenderness in variable degrees was present in a very large percentage of the cases. A stiffening of the proximal segment of the gut under the palpating hand is a very constant symptom and a valuable aid in diagnosis; as is visible peristalsis if present. A palpable mass was present in over half of our cases, *i.e.*, in twenty-six of them. The X-ray gave positive information in locating the growth and the extent of the constriction of the lumen of the gut in the eighteen cases in which it was taken.

In twenty-three of the patients the growth was located in the cæcum and ascending colon. In seventeen it was located in the splenic flexure, descending and sigmoid colon; and in the remaining seven in the transverse colon; which distribution gives a very high percentage in the right half of the colon and one that we feel would undoubtedly be different in a larger series of cases.

There were seven cases of acute ileus which demanded immediate operation, four of which died—three within thirty-six hours after operation and one eight days after operation. A cæcostomy was done in three cases and enterostomy in one, and one other in which cæcostomy was done survived but was in poor condition at the time of leaving the hospital. The two-stage Mikulicz operation was done twice in movable sigmoid growths; both survived, are living and apparently well to-day, eighteen months after operation. Much can be accomplished where this operation can be applied, as the growth can be eventrated and the obstruction can be relieved at the same time by a very quick and simple operation.

Since diverticulitis and carcinoma of the large intestine both occur most frequently after middle life, it is not unusual to confuse the diagnosis of perforated diverticulitis with perforation of a cancerous growth. Both may be insidious and gradual in onset, with the development of a tender and painful mass, rise in the temperature curve, and a distinct increase in the leucocyte and polymorphonuclear count; or the onset

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may be sudden, presenting the classical picture of a perforated hollow viscus.

Perforation had occurred in five of the cases at the time of admission, twice in the sigmoid and once in the descending colon; in each of which the pre-operative diagnosis was supposed to be an abscess from a perforated diverticulitis. All were drained, followed by radical operation later; one survived the second operation and was in good condition when last seen. In two the perforation was in the cæcum, both died, one in thirty-six hours and the other in eight days.

The microscopical diagnosis in all cases reported upon was that of adenocarcinoma; the adjacent mesenteric lymph-nodes were carcinomatous five times and hypertrophic several times, but showing no carcinomatous changes.

Primary resection with end-to-end, lateral or end-to-side anastomosis was done fifteen times with three deaths, a mortality of 20 per cent. The two-stage operation was done nine times, seven of which were of the Mikulicz type; in two a colostomy was done followed by excision with lateral anastomosis. There was one death, a mortality of 11 per cent. Permanent colostomy was done three times with no deaths; cæcostomy five times with four deaths. Six inoperable growths were explored, in four of which an anastomosis was done around the growth.

The average number of hospital days in the primary radical operation was thirty-two days; in the two-stage radical operation it was seventy-three days. Nineteen of the patients have been traced to the present writing, seven of whom have died:

One died six years after operation; one died three years after operation; one died two years after operation; one died one and one-half years after operation; three died four months after operation.

One is living six years after operation; one is living three years after operation; one is living two years after operation; one is living one and one-half years after operation; six are living one year after operation; two are living eight years after operation.

A SHORT ABSTRACT OF THE CASES LIVING

CASE I (B 5844).—Living six years post operation. Had palpable mass in ascending colon. X-ray not taken. Enterocolectomy with lateral anastomosis. Pathological report: Adenocarcinoma.

CASE II (A 14317).—Living three years post operation. Mass not felt before operation. Annular growth of the transverse colon. No X-ray taken. Two-stage Mikulicz operation. Pathological report: Adenocarcinoma.

CASE III (B 11867).—Living eighteen months post operation. Has gained considerable weight; is doing full-time work and feels perfectly well. Mass felt in left lower quadrant. X-ray positive. Partial colectomy of the descending colon with end-to-end anastomosis. Pathological report: Adenocarcinoma; metastasis not stated.

CASE IV (A 15064).—Living two years post operation. Physical examination negative. No X-ray taken. Carcinoma of the sigmoid. Two-stage Mikulicz operation. Pathological report: Adenocarcinoma; metastasis not stated.

CASE V (A 16898).—Living one year post operation. No mass felt. X-ray positive. Carcinoma of the transverse colon. Two-stage Mikulicz operation. Pathological report: Adenocarcinoma; gland metastasis.

CASE VI (A 16702).—Living one year post operation. No mass felt. No X-ray taken. Was a case of acute obstruction; immediate operation. Growth in the sigmoid. Two-stage Mikulicz operation. Pathological report: Adenocarcinoma with gland metastasis.

CASE VII (B 12471).—Living one year post operation. No mass felt. No X-ray taken. Carcinoma of the sigmoid. Partial colectomy with end-to-end anastomosis. Pathological report: Adenocarcinoma; no gland metastasis.

CASE VIII (B 12881).—Living one year post operation. Mass felt in right lower quadrant. X-ray positive. Carcinoma of the cæcum. Enterocolectomy with end-to-end anastomosis. Pathological report: Adenocarcinoma; gland hypertrophy; no metastasis.

CASE IX (B 12696).—Living one year post operation. Acute obstruction at the time of admission. No mass felt. No X-ray taken. Immediate operation. Growth in the sigmoid. Two-stage Mikulicz operation. Pathological report: Adenocarcinoma. Gland metastasis not stated.

CASE X (A 16381).—Living one year. No mass palpable. X-ray positive. Refused operation. Is still living. Condition poor.

CASE XI (B 13153).—Living eight months post operation. Mass in right upper quadrant. X-ray positive. Carcinoma of the hepatic flexure. Enterocolectomy with lateral anastomosis. Has gained thirty pounds and feels perfectly well. Pathological report: Adenocarcinoma with gland metastasis.

CASE XII (B 13605).—Living eight months. Incomplete obstruction. No mass felt. X-ray not taken. Growth in the transverse colon. Colocolectomy with lateral anastomosis. Pathological report: Adenocarcinoma with gland metastasis.

Our total mortality of 28.7 per cent. in all cases operated upon seems very high, but is accounted for in some degree by the extremely grave condition in which a large number of the patients were at the time of their entrance into the hospital.

There were seven cases of acute ileus, five of which were utterly hopeless. It would seem that the aforesaid mortality should be classed as a cancer rather than an operative mortality, since there were twenty-four radical operations with but four deaths, a mortality of 16.6 per cent. Hence, it is rather the graveness of the condition of the patient than the magnitude of the operation upon which the mortality depends.

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It should be proved in all cases of suppurative diverticulitis that the perforation is not of cancer origin.

Radical excision in the presence of any considerable degree of obstruction, though it be slight, is a dangerous procedure accompanied by a high mortality. A preliminary colostomy or the Mikulicz operation, where feasible, is a far safer and wiser procedure. Where there is no obstruction nor marked dilatation of the proximal segment the choice between the primary radical and the two-stage operation will depend upon many factors: the condition of the patient at the time of operation, whether he be fat or thin, the location and the mobility of the growth, etc., and the choice of the individual operator. It would seem from our series that primary radical excision in properly selected cases was the method of choice. Whether the anastomosis be lateral, end-to-side, end-to-end, or the Balfour modification of the end-to-end by the aid of a tube, etc., be done, are considerations that vary in the opinions of the different operators. There is, however, a marked tendency among some surgeons at the present time to show preference for the end-to-end anastomosis between the small and the large intestine as well as end-to-end anastomosis in the large intestine. The Mikulicz operation has a very important field, since it can be rapidly done and is a safer procedure in the hands of many surgeons with the added advantage of being applicable in acute ileus, and especially when the growth is located in the sigmoid.

An anastomosis around an inoperable growth will probably prolong life, is preferable and far more acceptable to the patient than a permanent colostomy, which should be deferred as long as possible in inoperable and obstructive conditions.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting held February 7, 1921

The President, DR. GEORGE G. ROSS, in the Chair

FRACTURES OF THE JAW

DR. GEORGE M. DORRANCE presented patients to illustrate methods of treating fractures of the mandible. In the first case, a fracture in the right canine region, the fragments were held in place by an interdental splint. Such a splint is indicated when there is a single fracture anterior to the second bicuspid in which the teeth are present. At times it may be used further back. It has the advantage that no external bandaging is necessary, and the patient can open his mouth to talk, swallow, etc.

Case II was a case of multiple fracture in which the fragments were held in place by intermaxillary splints which were soldered in place. This is the ideal splint, and is especially applicable in such cases. The advantage of the splints is that as soon as the fracture has been reduced and the splints applied, the treatment is practically finished, and it is only necessary for the patient to return for treatment about once a week. Whereas in cases where wiring is used, it is necessary to see the patient every few days.

Case III, a fracture of the body of the mandible at the canine tooth, was treated by intermaxillary wiring. This is an excellent method.

DR. ROBERT H. IVY remarked that the chief difficulty about interdental splints is to have them made. Ordinarily it takes a man two full days to make a splint, and the men who know how to make them are very few. Very often it is two weeks or longer before a splint is ready for use. Intermaxillary wiring was available while waiting for the splint, or might be used throughout the treatment. In twelve or fifteen cases which he had treated this winter he had seen only one in which the maxillary wiring was not adequate. In some cases no fixation is necessary at all.

DOCTOR DORRANCE rejoined that in the intermaxillary or the interdental splints when applied in cases which are suitable to each, the treatment of holding the fragments in position is practically finished. The wiring of the lower to the upper teeth will give satisfactory results, but requires continuous retightening of the wires from time to time. The splints, in other words, are the most refined and accurate method of fractures of the mandible.

INTERNAL DERANGEMENTS OF JOINTS

BROKEN NECK

DR. HENRY P. BROWN presented a man whose case was reported by him at the December meeting of this society, while the patient was still in the Pennsylvania Hospital. He is a man who sustained a fracture of the atlas and axis in falling during an attack of epilepsy. He wore a jury-mast extension for six weeks while in bed, and was then allowed out of bed with a plaster collar, and now wears a reinforced leather collar which supports the weight of his head on his shoulders. He has limitation of motion, especially in turning the head to the right; flexion and extension is about twenty degrees in each direction. He still has pain on making pressure over the atlas and axis on the right side of his neck, posterior. At no time has he shown symptoms of nerve involvement, as indicated by paralysis or anæsthesia. He asked whether Doctor Rugh still thought that a bone-graft operation is indicated in this case.

DR. J. TORRANCE RUGH replied that since the man had made a good recovery and has no symptoms he saw no occasion for interference. The time for operation is early when there are nerve symptoms, pains, and instability. Then he would not hesitate to place a bone graft.

SNAPPING JAW

DR. ASTLEY P. C. ASHHURST reported a case of recurrent unilateral subluxation of the mandible cured by excision of the interarticular cartilage, for which see page 712.

INTERNAL DERANGEMENTS OF JOINTS

DOCTOR ASHHURST also presented the following patients:

I. *Loose Cartilage in the Elbow-joint*.—Charles S., aged twenty years, was admitted to the Episcopal Hospital, September 14, 1920, referred by Doctor Levering. He had injured his right elbow in a fall more than three years previously, and a certain amount of disability had persisted since. His chief complaint was "inability to bend the elbow at times," and always there was pain on complete extension.

Examination showed nothing but tenderness at tip of olecranon in forced extension. Flexion was normal. A skiagraph, however, showed a loose cartilaginous body in the olecranon fossa.

Operation (September 17, 1920).—Longitudinal incision 7 cm. in length was made, splitting the triceps from the olecranon up. The loose cartilage (Fig. 1) was found occupying the olecranon fossa; it measured 1.5 x 1.25 x 1 cm. It was entirely unattached, but caught beneath the thickened posterior capsule. It was easily removed, and the wound was closed in layers. A splint was worn for a few days, when active use of the arm was allowed. Full function rapidly returned. He now has no disability whatever, and full flexion and extension.

II. *Recurrent Dislocation of the Internal Semilunar Cartilage in the Knee-joint.*—M. W., aged twenty-five years, was admitted to the Episcopal Hospital, December 18, 1920, with the history that in 1918 while playing base ball he "dislocated" his right knee; it was "reduced" on the field. Since then he has had five dislocations and has always been able to reduce them himself, until the present occasion (December 17, 1920), when he tripped over a line about three inches from the floor where he was working, and landed on the right foot; as a result his right knee locked and has been locked ever since the accident.

Examination.—The right knee is locked in flexion about 150 degrees. Can flex it slightly, but extension and external rotation cause pain. Internal rotation does not cause pain.

Operation (December 24, 1920).—Longitudinal section of patella, splitting also ligamentum mucosum which was found already detached from the intercondylar groove, and exposing a fractured internal semilunar cartilage: the fracture was about 2 mm. from the anterior end of its tibial attachment, and the remainder of the cartilage was only loosely attached. Each fragment in turn was caught in a sharp tenaculum and excised. There was granulation tissue in the intercondylar notch, an evidence of long-standing arthritis. Structures were closed in layers and a posterior splint applied for the first few days. January 7,

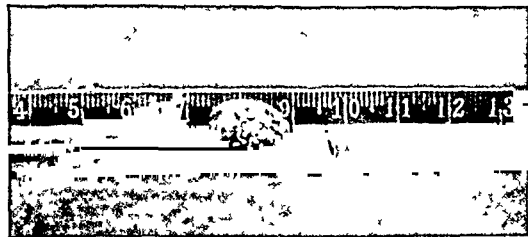


FIG. 1.—Case I. Loose cartilage in the elbow-joint. Scale in centimetres.

1921.—On crutches. January 19, 1921.—Without crutches. January 25, 1921.—Discharged. Flexion to 150 degrees. His knee now flexes to 120 degrees and is painless. (When seen in March, 1921, flexion was possible to 90 degrees and was still improving. No disability.)

III. *Arthrotomy for Multiple Intraarticular Exostoses in the Knee-joint, Following Suppurative Arthritis.*—A. W., male, a native of Cuba, was twenty-eight years of age when he came to the Episcopal Hospital in October, 1915. In 1910 while employed in the Panama Canal Zone he developed an acute arthritis of the left knee, following some injury. He was taken to a hospital, and two days later an operation was done, tubes being used to drain the joint. It was thought he would die. Later weight extension was applied. He was in bed four months in the hospital, and used crutches for six months after his discharge.

His chief complaint when he came to the Episcopal Hospital was that he could not run, and that he could not stand long or do any hard work. He worked in a cigar factory. There was creaking on motion in the knee, and the range of motion was limited (95 to 165 degrees only). The patella could scarcely be moved on the condyles. The stability of the joint, as regards lateral motion,

INTERNAL DERANGEMENTS OF JOINTS

was good. X-rays (Figs. 2 and 3) showed large masses of intraarticular new-formed bone, which evidently were the cause of the limited motion.

Operation (October 6, 1915).—Longitudinal section of the patella, the quadriceps tendon and the patellar tendon. It was very difficult to reflect the two halves of the patella because of bony masses at its lower border, not adherent by bone to the patella, but seemingly embedded in cartilage and fibrous tissue only. It proved difficult to excise these masses, but when once this was done, it was easy to reflect the halves of the patella, freely exposing the condyles. An exostosis the size of a plum arose from the external condyle,



FIG. 2.—Case III. Cartilaginous exostoses within the knee-joint.

and was excised. There was marked lipping at the upper anterior border of the condyles at the margins of the articular cartilage. The patella was concave on its lower surface, and lipped on all its borders. As these lips were well covered with fibrous tissue they were not removed. The wound was closed in layers, and the limb dressed on a splint. Operative recovery was uneventful.

December 15, 1915.—About ten weeks after operation, as the range of motion was still limited (165 to 180 degrees), the knee was forcibly flexed under nitrous oxide anæsthesia, a free range of motion from 110 to 180 degrees being secured.

February 28, 1916.—It was noted that the range of motion was 105 to 180 degrees.

June 18, 1919.—Motion 80 to 180 degrees. Can "run" now whenever he wants to. The patella feels normal, the scar is soft and supple, and though there is marked crackling on motion, and he says that if he works hard the knee swells and pains some, yet



FIG. 3 —Case III. Cartilaginous exostoses within the knee-joint.

he is entirely satisfied with the result and has very much less disability than before operation.

February 7, 1921.—His condition remains as at the last inspection, June, 1919.

DR. J. TORRANCE RUGH reported the removal of a cartilaginous body from outside the head of the radius at the elbow under local anæsthesia. The X-ray had failed to show anything and the case looked like one of tuberculosis. There was a history of injury of two years' standing. In examining the patient, however, he felt something slip under his finger, and then realized that he had a foreign body in a joint to deal with. The foreign body was readily removed.

DR. T. TURNER THOMAS said that some years ago he had a patient who

INTESTINAL OBSTRUCTION

could demonstrate to him that he had a foreign body in one of his knees. He said he had the same thing in the other knee. The doctor operated on the side where he could locate the foreign body and removed it. Because the man insisted that the same condition existed on the other side, he made two large lateral incisions and thoroughly explored this joint, but nothing was found and the two incisions were closed. He has never had any trouble in either knee since, and that was eight or ten years ago. We concluded that there was probably a loose cartilage in this other knee, that the contraction of the capsular ligament to which the cartilage is intimately attached, from the operation was enough to prevent dislocation of the cartilage.

INTESTINAL OBSTRUCTION CAUSED BY BAND FROM MECKEL'S DIVERTICULUM

DRS. EDWARD T. CROSSAN and (by invitation) DON G. LEW reported the history of a man, aged nineteen years, who was admitted 10.30 P.M., January 20, 1921, to the service of Dr. A. P. C. Ashhurst at the Episcopal Hospital. His chief complaint was pains in the right lower abdomen, which began five and a half hours before admission to the hospital. The patient was not nauseated and had not vomited. Has had a history of three previous attacks, the first one eight months ago, the second one five months ago, and the third one six days ago; each of these attacks was accompanied by vomiting and with only one day's duration, disappearing after a laxative.

He appeared to be in great pain and acutely ill. The abdomen was not distended, no bulging any place in the anterior abdominal wall.

Peristalsis audible but not increased. The right lower abdomen was rigid and extremely tender. Umbilicus abnormal, shaped like a small doughnut, being much elevated all around the periphery and depressed in the centre, three cm. in diameter. The remainder of the physical examination was negative. White blood count, 15,400. Urine showed a faint trace of albumin and occasional hyaline and light granular cast.

Doctors Crossan and Lew operated upon the patient, a Davis transverse incision being made and the appendix removed; the appendix was kinked in one place and congested, and on opening blood was found in the lumen and a small fæcolith at the tip. The cæcum and ileum showed

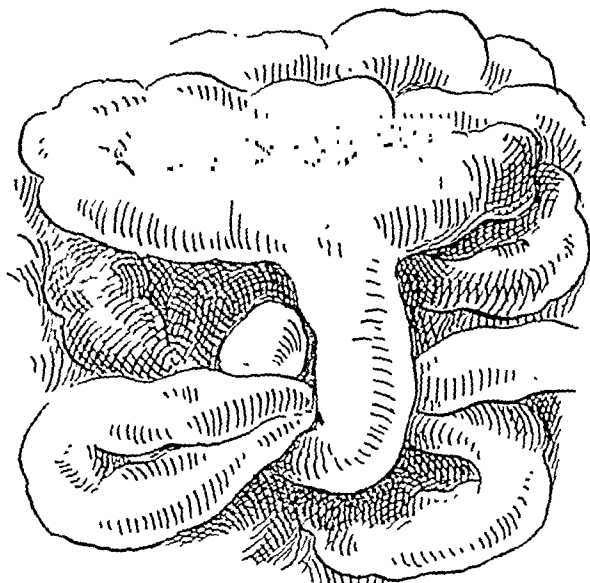


FIG. 4.—Diagram to show how a loop of small intestine was strangulated inside a loop formed by an adherent Meckel's diverticulum.

nothing abnormal at operation. The finger was introduced and swept around the anterior wall in region of the umbilicus, suspecting Meckel's diverticulum because of the queer-shaped umbilicus. Nothing was encountered and the patient was sewed up.

The next morning, January 21, 1921, patient said he had some pain still and vomited once for the first time. About 2.00 P.M. the patient had stercoraceous vomiting.

At 4.30 P.M. Doctor Ashhurst saw the patient and, recognizing the

acute intestinal obstruction, immediately reopened the abdomen under gas. A long, black coil of intestine prolapsed on opening the peritoneum; small intestines were distended and injected; sigmoid collapsed, containing scybalous masses; cæcum and end of ileum collapsed; an adherent mass in the pelvis delivered and found to be a Meckel's diverticulum, strangulating a mass of small intestines by an appendix-like structure adherent to the end of diverticulum about 1 x 6 cm., and attached to the pelvis (Fig. 4). The diverticulum was a pouch the size of a large hen's egg, wider at the base, springing from the anterior part of



FIG 5.—Specimen of Meckel's diverticulum. The ileum is seen running transversely above the large dependent diverticulum, into the fundus of this diverticulum a Paul's tube was sewn at operation (enterostomy). At the left of the diverticulum is shown the fibrous band which was adherent to the parietal peritoneum and completed the circle in which a neighboring coil of ileum became strangulated as indicated in the small sketch (Fig. 4)

the bowel opposite the mesenteric border (Fig. 5). The adhesions were divided and the prolapsed bowel was reduced by towel manœuvre and a Paul's tube sutured into the apex of the diverticulum. The patient's condition was poor following the operation. He grew steadily worse and died about forty-eight hours after the operation, apparent cause of death being toxæmia from paresis of the bowel and uræmia.

Post-mortem examination revealed nothing new outside of distended and congested bowels and congested kidneys. No peritonitis.

INTRACAPULAR FRACTURE OF THE NECK OF THE FEMUR

TREATMENT OF INTRACAPSULAR FRACTURE OF THE NECK OF THE FEMUR

DR. EUGENE C. MURPHY and DR. GEORGE M. DORRANCE presented a paper with the above title, for which see page 752.

DR. A. P. C. ASHHURST said it should be well to recognize that no method is infallible always. He had one patient in the Episcopal Hospital, a woman about fifty years of age, in whom he reduced the intracapsular fracture to the best of his ability by abduction, and treated her in an abduction case for the usual time, but on removal of the case the fracture simply fell apart, there being no union at all. This was corrected by implanting a bone peg.

In his opinion some of the skiagraphs shown in illustration of Doctors Murphy and Dorrance's paper are certainly not intracapsular fractures. At least one X-ray shown is clearly a "fracture through the trochanters."

DR. T. TURNER THOMAS said that in a former discussion of this subject he heard one surgeon in criticising this treatment say that it was cruel to put these old people in a plaster case. On that occasion Whitman argued that the case made for increased comfort, which opinion Doctor Thomas thought to be correct. Last summer he had a man over sixty with a fracture of the femur and an amputation of the thigh on the other side. He put an abduction case on him and an ordinary wood screw through both fragments, taking full weight on the fractured limb, with good motion in the hip-joint. He is now able to go about on crutches and his foot seems to be in good position.

DR. GEORGE M. DORRANCE said that some of these cases came to them almost moribund. After they were put in abduction plaster cases, it was surprising to see the difference. The case should be applied as soon as possible after the accident. They have been breaking up impactions, although not sure that it is best to do so. Seventeen to eighteen weeks is about the right time that these patients should be kept in the case. They should not walk for four or five weeks thereafter. There is firm fibrous union in these old people in from fourteen to fifteen weeks.

INTRACAPSULAR FRACTURE OF THE NECK OF THE FEMUR

DOCTOR ASHHURST reported the following case: Susan B., aged eighty-one years, was admitted to the Episcopal Hospital, April 21, 1920, one week after a fall down some steps in which she had injured her *right* hip. Skiagraphs (Doctor Bromer) showed "fracture of the neck of the femur with impaction; this also involves the great trochanter" (Fig. 6.)

The day after admission, April 22, 1920, under nitrous oxide anæsthesia, Doctor Ashhurst forcibly abducted the *right* hip and rotated it in, to secure permanent impaction; a plaster-of-Paris dressing was applied from axillæ to the toes. Bed-sores were present over the sacrum and the *left* heel.

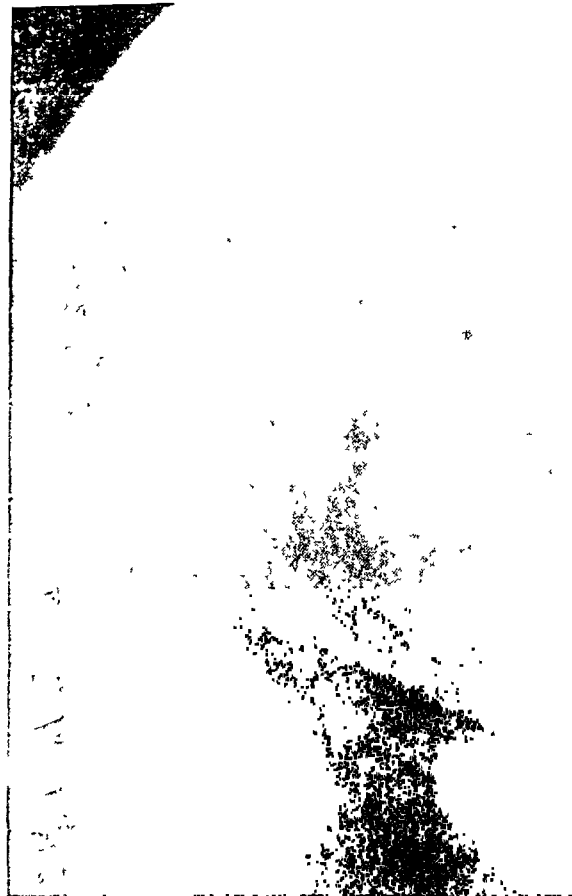


FIG. 6.—Intracapsular fracture of neck of right femur; skiagraph made April 22, 1920, on admission to hospital, one week after injury. Age, eighty-one years.



FIG. 7.—Intracapsular fracture of the neck of femur after ten weeks in abduction cast.

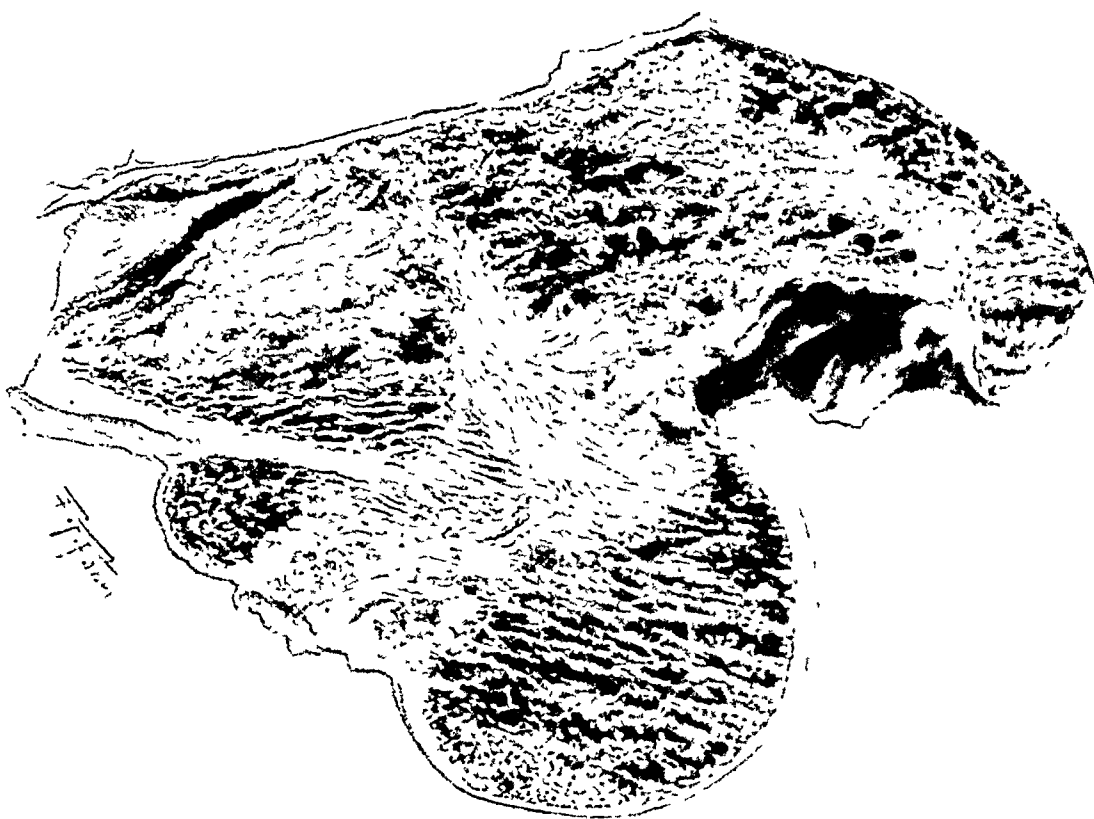


FIG. 8.—Specimen of ununited fracture of the neck of the right femur (intracapsular) secured nine months after injury, in a woman eighty-one years of age. The apparent impaction of the recent fracture is shown in Fig. 6, and the apparent union after treatment in an abduction cast is shown in Fig. 7.

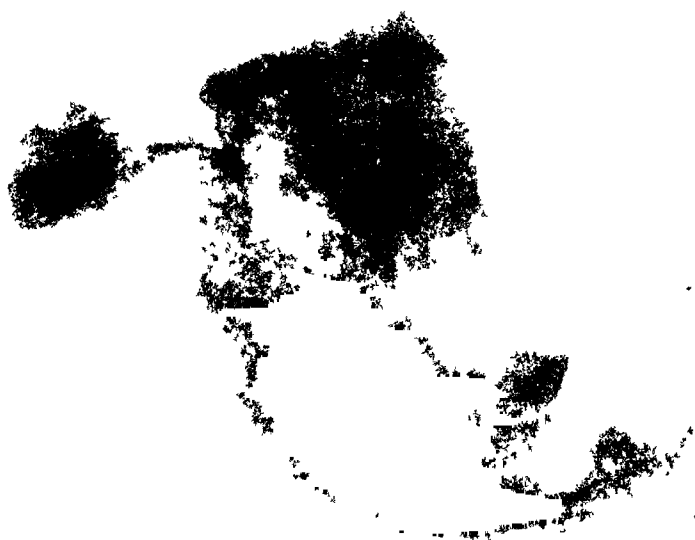


FIG. 9.—Skiaograph of post-mortem specimen of an intracapsular fracture of the neck of the femur. See also Figs. 6, 7, 8.

June 21, 1920.—The sacral bed-sores had healed; that over the left heel is granulating slowly. X-ray, "the old line of fracture can scarcely be seen; while there is considerable rarefaction there appears to be fair union" (Fig. 7). The case was removed piecemeal, from eight to ten weeks after the reduction.

August 15, 1920.—Up and about in chair. August 20th.—Learning to walk. August 24th.—Can raise right lower extremity off bed when lying on back, and flex hip and knee each about 30 degrees from full extension. Passive flexion of hip to 135 degrees and of knee almost to 90 degrees.

October.—Was able to walk entire length of ward (90 feet) with support. December.—Gradually weakening—confined to bed. January 2, 1921.—Died of asthenia.

The specimen, removed post mortem (Figs. 8 and 9), shows marked deformity as compared with the skiagraphic picture made after union was supposed to have been secured: the neck is almost wholly absorbed, the shaft fragment has ascended until the lesser trochanter catches on the head, and there is only fibrous union present. This indicates that (1) the original diagnosis of impacted fracture "at the base of the neck" was incorrect, the line of fracture being entirely intracapsular; (2) the fixation in abduction should have been continued much longer than eight or ten weeks; (3) walking should not have been permitted as soon as four months after injury. But in view of the patient's advanced age, and her comparative comfort under the method of treatment pursued, it is doubtful whether even if bony union had been secured, life would have been longer preserved.

DR. JOHN H. JOPSON showed the X-ray of the neck of a femur in a patient then under treatment. The patient was a young man aged thirty years. Four or five weeks ago while mounting his horse it fell and probably fell on him. He went back and forth to business in an automobile. At the end of three and one-half weeks he had X-ray pictures taken which showed a fracture through the middle of the neck of the femur, apparently without much deformity; undoubtedly there was some impaction. The man was put up in a plaster case from the lower thorax to the ankle. Recently Armitage, after a careful review of the condition and a careful study of the vascular supply, shows why we do not get union in elderly people. The blood supply in young life is rich; as the person advances in life the blood supply decreases. The reason healing does not occur in the advanced person is the presence of disease in the absence of a rich blood supply. We get the ideal result only in the exceptional case.

SPECIMENS OF FRACTURE OF THE VERTEBRAL COLUMN

DR. ASTLEY P. C. ASHHURST and (by invitation) DR. A. A. WALKLING presented the following specimens from the service of the former in the Episcopal Hospital:

SPECIMENS OF FRACTURE OF THE VERTEBRAL COLUMN

FIG. 10.—Specimen of fracture of the eleventh dorsal vertebra, spinal cord crushed against the posterior upper margin of the eleventh. Removed at autopsy three and one-half months after injury.

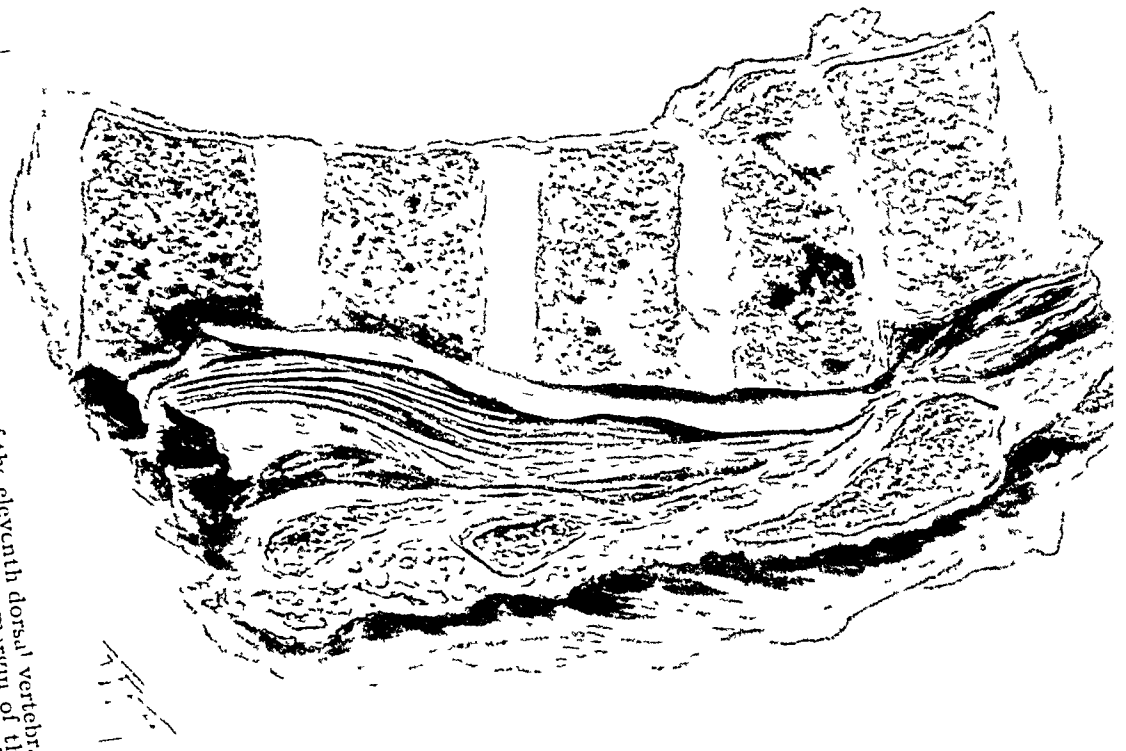
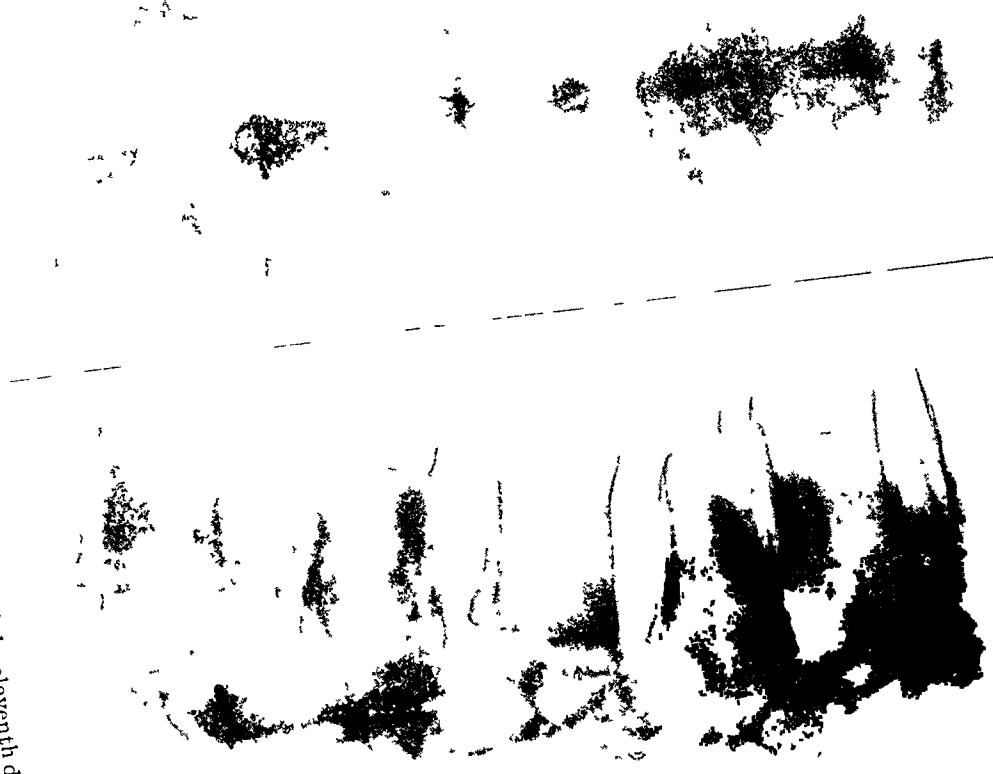


FIG. 11.—Skullgraph of the post-mortem specimen of fracture of the eleventh dorsal vertebra



Jacob U., aged fifty years, admitted to Doctor Ashhurst's service in the Episcopal Hospital, October 12, 1920; died December 15, 1920. August 31, 1920, he fell about ten feet and landed on his back; was unconscious at first and on recovering consciousness found that he was paralyzed from the waist down. He was taken at once to a hospital in Springfield, Mass., where the accident occurred, and there a suprapubic cystotomy was done. He was brought to his home in Philadelphia to die.

Examination indicated a complete lesion of the spinal cord at the level of the eleventh or twelfth dorsal vertebra. A skiagraph (Dr. R. S. Bromer) showed fracture of the body of the eleventh dorsal vertebra, with forward displacement of the tenth. The bed-sores present on admission gradually improved; but early in December the patient developed fever, probably from infection of the kidneys and bladder; also a lymphangitis of the right lower extremity. He gradually failed and died December 15, 1920, three months and a half after his injury.

This specimen (Fig. 10) was secured by Dr. A. A. Walkling, resident pathologist, at the autopsy, which also showed acute cystitis and ureteritis on the right; early pyonephrosis on the right, and chronic interstitial nephritis on the left.

The specimen shows clearly the forward displacement of the tenth dorsal, how the upper posterior border of the eleventh dorsal vertebra crushed the cord; it shows the triangular fragment of this vertebra broken off the upper anterior portion of its body, and the bony union which has occurred. Fig. 11 is from skiagraphs of the specimen.

FIBROMA OF THE OVARY

DOCTORS ASHHURST and WALKLING presented an ovarian tumor removed from a woman sixty-five years old who was admitted to the Episcopal Hospital December 7, 1920. Chief complaint—incontinence of urine for past three months, during which time she had had a dull aching pain in the right groin. Menopause at forty-nine years of age. Vaginal examination showed a large immovable mass posterior to uterus, filling entire true pelvis; cervix and uterus also almost immovable. Pre-operative diagnosis: Uterine fibroid, subperitoneal, impacted in pelvis.

Operation (December 10, 1920).—A fibroma of the ovary, firmly impacted in pelvis, was removed. Right tube removed with tumor. Left tube, seat of hydrosalpinx, also removed.

On the thirty-sixth day post-operative, up in chair—short of breath; back to bed. Four days later, up in chair again—no heart symptoms. Four days later, walking with nurse's aid—no symptoms. Two days later, January 26, 1921, she died suddenly while up and about the ward. Autopsy showed cause of death to be myocardial degeneration.

The specimen consists of a dense fibrous tumor measuring 12 x 6 x 4 cm. and weighing 170 grammes. (Fig. 12.) Microscopical examination: Fibroma.



FIG. 12.—Fibroma of ovary removed by laparotomy from a patient 65 years of age.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Regular Meeting held February 9, 1921

DR. WILLIAM A. DOWNES, President, in the Chair
BIRTH PALSY

DR. A. S. TAYLOR presented a child three years of age, who was first seen by him when an infant of five and one-half months. She was a vertex. Labor was difficult and instrumental. She weighed ten pounds. There was a swelling in the right side of the neck which disappeared in two weeks. On the second day it was noticed that the right arm did not move. On the tenth day the fingers began to move and there has been some further improvement since. She was healthy and normal except for the right upper extremity, which was in characteristic position by the side, elbow extended, humerus rotated inward, forearm fully pronated, wrist flexed forty-five degrees and ulna adducted. The digits could be moved with fair freedom. The wrist could be very slightly extended. No supination was possible. No flexion of the elbow was possible. There was no power of abduction or external rotation at the shoulder. The shoulder was dislocated posteriorly. The pectoralis major was rigidly contracted. The extremity as a whole could be moved forward about thirty-five degrees. It was smaller than the left extremity, and the muscles softer. A cicatrix is felt in the right plexus.

Operation (April 11, 1918).—C. V., VI. and VII. were found badly torn and the ends united by a solid cicatrix about 1.5 cm. long. This was resected and end-to-end suture of the freshened stumps made with chromic gut. She made an uninterrupted recovery.

One year after operation she could abduct the shoulder through the full range to nearly vertical, could rotate the humerus outward almost to the normal limit. The subluxation of the shoulder was almost gone spontaneously. She could flex elbow completely, could supinate about 75 per cent. of normal, moves the digits and wrist freely and with strength. She can put her palm to her mouth, on the top and on the back of her head.

To a question as to how early he liked to operate on these cases Doctor Taylor replied that in cases in which there was no question as to the necessity for operation three months was the optimum time if the arm was held in proper position up to that time. The great difficulty was that these cases were likely to go without proper support to the arm and developed secondary deformities as the result of the nerve paralysis. He would say that three months was about the optimum time for operation.

CASE I. *Neurofibromle*.—Dr. A. S. Taylor presented a woman, aged thirty-six years, who, in November, 1913, felt stiffness in the neck on awakening. In January, 1914, developed pain between scapulæ: usually appearing at night: relieved by getting up and walking. If she rested during the day the pain would appear. In June, 1914, the pain spread to the shoulders and down the arms to elbows. The pain was sometimes sharp and stinging and sometimes a dull ache. Sometimes the arms felt heavy and sometimes felt pinched. In September, 1915, she first noticed trouble in climbing stairs, especially with right leg. Any jolt or jar caused sharp pain between the scapulæ. In October, 1915, the feet became numb and this numbness crept steadily upward. In December, 1915, she lost power in the right upper extremity which also became numb. Soon the left upper extremity was also involved. In early January, 1916, she became bedridden with loss of sphincteric control.

She was a medium-sized woman, well nourished and of fair color. The upper level of anæsthesia to all types of stimuli ran across the chest just below the first ribs and down the ulnar half of the arm, forearm and hand on each side. There was marked loss of power in the upper extremities and complete loss in the lower extremities. The sphincters were paralyzed.

The K. J.'s and A. J.'s were exaggerated. Babinski and Oppenheim reactions were present on both sides. Blood and spinal fluid Wassermann's were negative. Spinal fluid culture was negative.

Diagnosis.—Spinal cord tumor about the level of D. I.

Operation (January 31, 1916, at the New York Hospital).—A right unilateral laminectomy involving C. VI., VII. and D. I. and II. was done. A tumor was felt beneath the exposed dura, which was then split longitudinally. A soft, friable, lobulated, vascular tumor about $3\frac{1}{2}$ by 1.5 by 1 cm. at its thickest portion extended from C. VII. to D. II., lay beneath the arachnoid, lay chiefly on the right side of the cord running forward laterally, and also extending a little to the left of the median line dorsally. It peeled out readily, having no adhesion to the cord substance proper. The posterior veins of the cord were intensely engorged and the cord was somewhat flattened postero-laterally. The dura was closed by fine catgut, and the superficial structures by layer sutures.

On the sixth day she recovered bladder control. On the thirty-fifth day she recovered bowel control. On the fortieth day she took a few steps. She made rapid progress to complete recovery.

The healing was perfect, the spinous processes are present and give an absolutely normal appearance to the spine. A number of surgeons emphasize the statement that this procedure ought never to be used.

CASE II. *Endothelioma of the Dura*.—Dr. A. S. Taylor presented a second case, a woman, aged thirty years, who in December, 1917, had pain in left lower dorsal region. Jolting increased this pain. Six months later the pain had spread to the right side and was more severe and persistent. In October, 1918, there was a left drop-foot

and spasms of muscles in right leg. In January, 1919, left leg was paralyzed, and the feet felt numb. The right leg soon began to lose power. In April, 1919, there was partial loss of sphincteric control. There was constant pain about the waist.

She was a tall, slender, pale woman. Left lower extremity was paralyzed. Right showed slight muscular power. Sensory disturbance extended up to the level of D. IX. on the right side and D. VIII. on the left side with a zone of hyperæsthesia one segment above on each side. There were some irregular areas on the right leg and foot where touch or pin prick or both were appreciated. She could not tell the position of any of her toes. The abdominal reflexes were absent. K. J.'s and A. J.'s exaggerated on both sides L. 7 R. Left ankle clonus is almost inexhaustible. Right ankle clonus is about one-half as persistent. Babinski and Oppenheim present on both sides. Blood and spinal fluid Wassermann negative. Spinal fluid normal. Tenderness over the spines of D. VI. and D. IX.

Operation (May 7, 1919, at the New York Hospital).—Left unilateral laminectomy, involving D. IV, V., VI., and VII. Beneath exposed dura a circumscribed tumor was felt extending from D. V. to D. VII. The dura was split and a soft, purple, capsulated tumor about 4 by 1 by 1 cm. was exposed. It was adherent to the dura just below and behind the root of left D. V. This small piece of dura was excised and the tumor lifted out with it. The tumor showed two constrictions which made an upper large lobule and two smaller lower ones. The tumor was entirely left postero-lateral and had caused two shallow compression areas in the cord. The wound was closed by layer sutures without drainage. Recovery rapid and uneventful. On the thirteenth day she walked twenty-two steps and was taken home where she made a complete recovery.

Pathological Report: Endothelioma of the Dura (Psammoma).—Here again the unilateral laminectomy gave a perfectly satisfactory exposure and working field.

DR. HAROLD NEUHOF stated that in regard to the hemilaminectomy, Doctor Taylor had inferred that it was indicated in some cases. It had proved unsatisfactory in his hands. It was his impression that the exposure obtained by a unilateral laminectomy was not adequate for a general exploratory investigation. If the localization of the lesion was clear as in Doctor Taylor's case in which the tumor lay on the right side, then a hemilaminectomy might be satisfactory and might fit that situation well, but the operation was one having strict limitations. The basic principle is not whether one approaches the cord by a hemilaminectomy or by a total laminectomy, but that the exposure shall be such that the cord shall be exposed to the minimum manipulation, and manifestly the minimum of manipulation of the delicate structures was secured with a total laminectomy. Doctor Taylor had spoken of preserving the spinal processes for the sake of preserving the external contour.

He did not think that was a particular advantage, as the space occupied by the spinal processes removed by the total laminectomy is filled in with muscle and fascia, so that a normal external appearance is preserved.

DOCTOR TAYLOR said he had seen a number of bilateral laminectomies in the neck where the ligamentum nuchæ had been damaged. Being deprived of their elastic support these patients complained of more or less neckache because their muscle had to substitute for it. In the cervical region hemilaminectomy gave ample opportunity to do any operation. If the tumor was on the front part of the cord he thought it could be reached better by the lateral laminectomy. Hemilaminectomy had been sweepingly condemned, often by men who had given it no fair trial. The point he wished to emphasize was, it could not be done well unless one had tools adapted to the purpose. The ordinary tools found in the operating room were not adapted to hemilaminectomy. While the field for this procedure was distinctly limited, it had served a most useful purpose in many patients.

POST-OPERATIVE ABDOMINAL ADHESIONS AND ANOMALOUS MEMBRANES

DR. A. S. TAYLOR presented a woman, fifty-one years of age, who in 1905 had an attack of acute pain in the right lower quadrant for one whole night. Although she was not confined to bed, she thereafter suffered constantly from pain and tenderness in the R. L. Q., and from gastric pain, flatulence and constipation. In 1907 the appendix was removed and the gall-bladder explored. In 1909 she had typhoid fever and following recovery from that she seemed perfectly well until 1916, when she developed muscular rheumatism, followed about six months later by digestive disturbances, pain, flatulence and constipation. In 1917 the removal of abscessed teeth caused the disappearance of the muscular rheumatism, but the digestive disturbances persisted and increased. In 1918 she suffered a serious "nervous breakdown" incapacitating her for her work for about six months. In February, 1919, her digestive troubles had become almost unendurable in spite of prolonged medical treatment of the best quality.

She was a woman of small stature, well nourished, of fair color, with drawn expression. The ascending colon, markedly distended with gas, could be rolled under the fingers and was quite tender to pressure. The X-ray series showed the cæcum mostly in the true pelvis, and it and the ascending colon showed considerable dilatation and retention of barium. At the hepatic flexure there was distinct kinking and narrowing of the lumen of the gut.

The abdomen was opened at the New York Hospital March 8, 1919, through a transverse right rectus incision 2 cm. above the level of the umbilicus. Dense adhesions were found binding the outlet of the stomach, the transverse colon and upper ascending colon to each other and to the

edge of the right lobe of the liver; dense adhesions 3 cm. wide between the omentum and the whole length of the old incision; adhesions between omentum and ascending colon producing sharp kinking of the hepatic flexure; adhesions about the cæcum; a band across ascending colon, causing kinking and constriction.

The adhesions and bands were dealt with by tedious dissection and separation, and the covering in of raw surfaces wherever possible. As a result the viscera were mobilized, but there were many raw surfaces which could not be covered over. The wound was closed by layer sutures.

For the first nine days of the post-operative period there was great gas distention with constant severe pain, especially in the sigmoid region. Phlebitis appeared in the left femoral and external iliac veins toward the end of the first week.

On the ninth day the sutures were removed and there was good primary union. Convalescence was slow but steady. She sat up on the thirty-fourth day and left the hospital on the fifty-sixth day. The after-treatment was aimed at keeping the gut mobilized and at preventing permanent adhesions if possible. It consisted in abdominal massage with the colon filled with hot water; daily exercises for the abdominal muscles; and deep breathing exercises. The diet was carefully supervised and laxatives were used at first.

She made steady improvement, and nineteen months after operation reported that she had gained weight and color, had good appetite, no discomfort after food, had regular daily movements and no trouble with gas. For a year she had taken no cathartic except an occasional dose of agar-agar or an occasional enema. The abdomen showed no tenderness to pressure anywhere, there was no distention, and both scars were flexible. She was extremely faithful in her part of the after-treatment. The chief point of interest in the case lies in the effect of systematic after-care in the prevention of crippling post-operative adhesions.

DOCTOR DOWNES asked Doctor Taylor why he waited thirty days to start the colonic irrigation and massage and whether he did not think the adhesions had reformed by this time. If one was going to use irrigation and massage he thought it ought to be employed immediately. Doctor Downes said that in order to prevent this he moved his patients from side to side soon after they came out of ether. He also used colonic irrigation and mild cathartics, but he did not wait thirty days. If one waited thirty days one felt that the patient was back where he was before the operation, so far as the adhesions were concerned.

DOCTOR TAYLOR admitted that his success in this case might have been due to good luck. He was sure, however, that if they had seen this patient before the end of thirty days, colonic distentions would not have suggested themselves, as she had about all she could endure in the way of discomfort. Adhesions thirty days old were not as bad as when they were five or six years old. Of course, one case did not prove anything.

That this patient was reasonably well made him think not that the method was a cure for adhesions, but that anything that had seemed to help was worth while reporting. He had used this method in the after-treatment in ordinary laparotomies and he had had better results than when it was not included.

CERVICAL RIB

DR. A. S. TAYLOR presented a man, aged twenty-two years, who in April, 1920, noticed that his right upper extremity was larger than the left and was cyanotic and cold. It tired much more quickly than formerly. Once he had tingling in the first three fingers, but never any real pain.

Examination showed the right upper extremity to be larger than the left by 3 cm., both in the arm and forearm, the veins twice as large and the whole extremity cyanotic. No atrophy, no obvious loss of strength, and no change in sensibility. On the right side of the neck at the level of C. VII. vertebra there was a bony prominence, apparently a cervical rib. Just below and in front of this prominence is the subclavian artery which is well above the level of the clavicle. Pressure upon the lower roots of the brachial plexus as they run over this prominence causes tingling in the fingers. The left side of the neck seems to be normal.

X-ray picture shows the transverse processes of C. VII. to be large and heavy, and to extend beyond the level of the transverse processes of D. I., especially on the right side.

Operation (June 18, 1920, at the Fordham Hospital).—An incision was made, oblique upward and outward over the tip of the transverse process of C. VII. right side. The brachial plexus was mobilized forward and inward. The scalenus muscle was split down to the tip of the rudimentary rib, which was then freed from the surrounding soft tissues by dissection, so as not to elevate its periosteum which must be removed with the bone.

The tip of the rudimentary rib projected .5 cm. beyond the posterior tubercle of the transverse process and extended downward nearly to the first rib. From its tip and lower border firm fibrous bands stretched downward and outward onto the first rib. Over these bands C. VIII. and D. I. passed, but did not seem to suffer from pressure. After the bands were divided the rudimentary rib was removed by rongeur except for its innermost part. The wound was closed without drainage.

On recovery from ether there was numbness of the entire extremity, complete loss of power in the shoulder muscles, and marked loss in the other muscles. On the second day the cyanosis and enlargement of the veins had disappeared, the numbness and loss of power became less and he went on to a rapid recovery and has been well ever since. On the twenty-fifth day the right forearm was 0.3 cm. larger and the upper arm 1.2 cm. larger than the left, as compared to 3 cm. difference preceding operation.

REMOVAL OF GASSERIAN GANGLION

DOCTOR TAYLOR stated that he had done a half a dozen of these operations, some bilateral and some unilateral, using the same exposure that he did for brachial plexus operations. This was ideal for cervical rib cases because the chief difficulty was to avoid any paralysis from pressure on the brachial plexus. The first case had paralysis from the retraction of the brachial plexus. The incision was made from the sternoclavicular notch upward and backward over the tip of the transverse process of the seventh cervical, which gave a perfect exposure. He went back of the brachial plexus and exerted no undue tension, and cut the rib close up to its articulation with the vertebra. It was almost impossible to remove it at the articulation, as there was danger of damaging the vertebral vein and causing troublesome hemorrhage.

SUPRAORBITAL NEURALGIA—REMOVAL OF GASSERIAN GANGLION UNDER LOCAL ANÆSTHESIA

DR. A. S. TAYLOR presented a man, aged fifty-nine years, who in July, 1917, first had a sudden attack of sharp, shooting pain over the right eye. It lasted a few minutes and suddenly disappeared. This pain could be precipitated by touching the upper face with cold water or exposure to cold draft. The pain gradually became more frequent in occurrence and more severe in degree.

On July 1, 1918, after it had lasted for a year, the supraorbital nerve was avulsed and he got complete relief for eleven months. At the end of that time a similar operation was tried again but with no result. There is now also occasional pain in the second branch. His general health has remained very good.

Careful neurological examination showed only hypæsthesia over the area of the right supraorbital nerve (post-operative). The radial arteries were somewhat tortuous and palpable, indicating possible arteriosclerosis. The right eye showed only slight perception and slight perception of motion. Its pupil was fixed and irregular. Also there was some incoordination of the movements of the right eye (this is the result of an injury in 1894).

Because of his attacks of pain over a period of four years, because of the failure to get relief by peripheral procedures and because of the pains having become so severe and frequent as to incapacitate him, it was deemed advisable to operate. The pain was of the characteristic lightning type.

Operation (January 25, 1921).—Morphine was administered $\frac{1}{8}$ of a grain one hour before operation, and this dose was repeated thirty minutes later. The soft tissues of the operative field were infiltrated with novocaine, $\frac{1}{2}$ per cent. with adrenalin 1-100,000, some twenty minutes before the operation was started. The patient was placed in a semi-sitting posture with the head turned toward the left. Incision was made from the middle of zygoma upward and slightly backward for a distance

of 7 cm. This incision was carried down through the skin and aponeurosis of the temporal muscle, the fibres of which were then split until the bone was reached. The muscle was then elevated from the underlying bone with an elevator. The aponeurosis was divided at the zygoma for 1 cm. forward and backward of the incision to permit more freedom in retraction. A self-retaining retractor was placed in the wound and the blades separated. This exposed an area of bone about 3 cm. wide and considerably longer in a vertical diameter. The bone was perforated and then removed by means of a rongeur which removed an area of squamous bone about 4 cm. in diameter, and encroached on the floor of the skull a little beyond the temperosphenoidal ridge. The dura was elevated gently from the base of the middle fossa. This procedure was quite painful to the patient. The dura was somewhat thickened and more adherent to the bone than usual. The dura was elevated until the middle meningeal artery was exposed. This artery was avulsed from the dura, pinched for a moment or two with a clamp, and then tucked down in the foramen spinosum where it gave no further trouble. Attempts to elevate the dura further were quite painful, so that some of the anæsthetic solution was placed on a pledget of cotton in the depth of the wound, and also by means of a long slender needle some of it was injected into the capsule of the ganglion. After waiting a few moments manipulations could be again started with greatly diminished pain. The third branch from the ganglion was identified, the overlying dura divided, and the canal from the posterior fossa over the petrous bone into the middle fossa was opened with some escape of spinal fluid. The root of C. V. could not be seen. There was a thick, dense layer of fibrous tissue which formed the floor of the canal just mentioned. Pressure upon this floor caused sharp pain in the distribution of C. V. This thickened floor was split longitudinally, and beneath it lay the root of the nerve. The nerve hook was placed around the root and an attempt made to avulse it. This caused great pain and the root did not give way as it customarily does with slight traction. Therefore, the only thing left was to divide the root where it was exposed. This was done by means of scissors when the root was elevated on the nerve-hook. The canal in which the root lay was carefully inspected to see that no fibres had escaped. After the root had been completely divided with the hope of getting a specimen for the pathologist, the stump of the posterior root was grasped with thumb forceps and an attempt made to avulse it. It did not yield at all and the pain was so great that the attempt was given up. There was little or no hemorrhage at the end of the procedure, and the wound was closed by layer sutures. The man was returned to bed in good condition, the operation having lasted about one and three-quarters hours. The special feature about this operation under local anæsthesia is the very great freedom from hemorrhage.

The post-operative course was uneventful. He had the usual dull

MUSCULOSPIRAL PARALYSIS

headache which most of these patients have for the first two or three days. On the second day he sat up in a chair and thereafter sat up every day. He began walking around on the third day. The sutures were removed on the fifth day and he had a good primary union. He returned home on the eighth day in good condition with the wound firmly healed and with a typical anæsthesia over the area supplied by the right C. V.

His maximum temperature following the operation was 101.4° twenty-four hours after his operation. On the third day it was normal and so remained thereafter.

MUSCULOSPIRAL PARALYSIS

DR. A. S. TAYLOR presented a man who had been operated upon in the days of the "Lane plate." Following the operation he had musculospiral paralysis, and a second operation was done on the musculospiral nerve which was said to have been an end-to-end suture. Three years later he came to the Neurological Institute. There was a separation of the torn ends of the biceps and brachialis anticus muscles and a defect of four inches in the musculospiral nerve. This was bridged and the upper and lower parts of these muscles sutured with strong silk sutures. Moderate power of flexion of the elbow has resulted.

The reason Doctor Taylor brought the patient was to ask these questions: (1) Would it be worth while to try another nerve graft? (2) Would one be entitled to resect three inches of the humerus? (3) Whether one would perhaps increase the amount of union of the muscle and get better function by bone resection? (4) Would bone-grafts rendering the wrist rigid in extension improve the value of the finger flexion, or would it be better to do tendon transplantation to overcome the drop-wrist?

HYGROMA OF NECK THREE YEARS AND EIGHT MONTHS AFTER OPERATION

DR. CHARLES N. DOWD said that about eight years ago during a single year three cases of hygroma of the neck came to his notice (ANNALS OF SURGERY, July, 1913) and since that time an occasional reference to other cases has been noted. The pathology of this condition has been well worked out as being a sequestration of the embryonic lymph-vessels. Arnold, of Heidelberg, had carefully studied the problem and had described the condition many years ago. The origin was apparently from the developing lymphatic system. The prognosis was not always good.

He now presented a child, five years of age, as an example of an advanced degree of hygroma in whom a satisfactory cure has been obtained by operation.

She was first seen October 24, 1916; when fifteen months old. At birth there was a soft lump at the right of neck about the size of a hen's egg. This increased moderately for thirteen months, but had grown very rapidly for two months. The child looked weak and feeble. Her birth

had been premature and she had only reached a weight of thirteen pounds two ounces at the age of fifteen months. She had not gained at all in weight during her first seven months.

There was a lobulated, thin-walled, cystic mass which projected from the entire right side of the neck from the ear outward and downward, over the shoulder and backward on to the scapula. It had an elastic feel and was faintly translucent. It had a transverse band across it. The diameter of the lower portion was four inches.

Her condition was so bad that an operation did not seem advisable at that time.

On December 2, 1916, an effort was made to withdraw fluid by aspiration and 2 c.c. of thin fluid was withdrawn and $\frac{1}{2}$ c.c. of $3\frac{1}{2}$ per cent. tincture of iodine was injected. At this time it was evident that there were many loculi in the cyst, for only a little fluid could be withdrawn.

The child was kept under observation and treatment for six months. During this time an unsuccessful effort at radium treatment was made. She was so debilitated and weak that it was doubtful whether she would ever gain enough strength for an operation.

By June 4, 1917, she had gained as much as she seemed likely to gain, hence an excision of the hygroma was done.

A long transverse incision was made from the clavicle across to the scapula. The lobulated growth was dissected out completely. Its attachments ran in close to the transverse cervical vertebra, downward behind the clavicle, backward over the scapula and outward to the tip of the shoulder. Its walls were thin and contained limpid fluid. Its gross appearance and the pathological report both indicated that it was a hygroma.

She made an excellent recovery and is apparently free from recurrence. Since nearly four years have now elapsed since the removal of the growth there is good reason to believe that her cure is permanent. She has gained satisfactorily in strength and now has the appearance of a normal, healthy child.

PARTIAL COLECTOMY FOR HIRSCHSPRUNG'S DISEASE

DR. CHARLES N. DOWD presented a child who was first seen by him on March 21, 1920. She was then ten and one-half years old. During the first seven years of her life she had enjoyed good health, then she began to lose strength and was quiet and listless. When she was eight and one-half years old she began to have severe attacks of abdominal pain in the epigastrium on both sides. These came on at irregular intervals and were accompanied by constipation. Her disability increased continually and by December, 1919, she had become a real invalid, going about from one doctor to another, seeking relief from her distress, weakness, pain and alternating constipation and diarrhoea. She vomited only once. Micturitions were frequent. Her mother described her as "always cramped with pain and diarrhoea."

She was thin and emaciated, and had a large abdomen. There was a mass in the left side which felt remarkably like a kidney tumor. This, however, disappeared with colon irrigations after a very large discharge of fecal matter. Intestinal washings were tried for a time, but disability and general wretchedness continued. X-ray pictures showed a dilated colon.

An operation was done on April 10, 1920. The transverse colon presented in the wound and was extremely dilated. The sigmoid also presented in a similar way.

It was not practicable to remove either of these portions without removing both, hence the outer leaf of the peritoneum was cut beside the splenic flexure, the entire transverse and descending colons were then mobilized, the mesenteric attachments were divided and the colon from the hepatic flexure to the lower sigmoid was delivered through an intramuscular incision above the left anterior iliac spine. They were fastened there and the median wound was then closed and protected with gauze and adhesive plaster.

The intestine was ligated at its exit from the abdominal wall and the protruding part ablated. The ablated portion was 40 inches long, $3\frac{1}{2}$ inches in diameter, and easily held four quarts of fluid. The stoma was allowed to open in the second day; was closed on May 28th.

The child has made a good recovery, has gained steadily in strength and weight, her bowels move daily, an X-ray picture shows an efficient though short colon, she has regained her good disposition and seems like a normal child.

DR. CHARLES H. PECK presented a woman, aged thirty years, who was operated upon at the Roosevelt Hospital on October 14, 1915, for persistent constipation of an extreme degree, with marked constitutional symptoms of fecal stasis and auto-intoxication. Her statement that she frequently went two weeks and sometimes three weeks without a movement was corroborated by her physician and her nurse.

X-ray plates taken by Doctor LaField showed a condition of pronounced megacolon, with great dilatation and enlargement of transverse, descending, and sigmoid colon.

Doctor Peck stated that he was not in any sense an advocate of colectomy for constipation operation, and that this procedure was advised only after careful deliberation and consultation with her family physician and Doctor LaField, both of whom were convinced that the condition was so extreme as to demand surgical interference.

On exploration, peritoneal bands binding down and obstructing the colon at the splenic flexure were divided, but owing to the great elongation and dilatation of the transverse and descending colon and sigmoid, a lateral anastomosis was done between the transverse colon at the junction of its right and middle thirds and the lower sigmoid, hoping thus to

short-circuit the fecal current and avoid its passage through the major portion of the distended gut. As might have been expected, this plan was a failure and simply resulted in overloading and continued stasis in the great loop of large intestine, although the anastomotic opening remained widely patent.

The patient tried to believe that there was some clinical improvement for a year or so, but symptoms were soon as bad if not worse than ever.

In the summer of 1918, during Doctor Peck's absence, she was again operated upon in Boston, adhesions being separated, but no direct attack on the intestine being attempted. A large ventral hernia followed this operation, and through the hernia an enormous fecal tumor could be felt filling the upper left abdomen.

A third operation was performed on March 20, 1920, the isolated loop of gut, consisting of two-thirds of the transverse colon, descending colon and sigmoid, was enormously distended and filled with fecal matter. The old anastomosis was widely open, admitting four fingers easily.

Partial colectomy was performed, removing the entire dilated segment including the old anastomosis, and end-to-end suture was performed between right part of transverse colon and the lower sigmoid just above the pelvic brim. The ventral hernia was repaired by lateral overlapping, the operation taking two hours. A good recovery ensued without complications and the fourth day the bowels moved without catharsis or enema. She has continued to improve, has gained in weight and is completely relieved of the symptoms of auto-intoxication.

The segment removed measured 132 cm. (55 inches) in length, and from 4.5 to 9 cm. in diameter; the intestinal wall was thinned and the lumen greatly dilated.

CYST OF THE MESENTERIOLUM

DR. CHARLES N. DOWD presented a woman, aged forty-two years, who first came to the Roosevelt Hospital on December 15, 1920. She had been in good health until three weeks before that time, when she had an attack of severe pain in the region of the vermiform appendix. This subsided in fifteen or twenty minutes, but had recurred frequently at various irregular intervals without fixed relation to food intake and with no discoverable cause. The attacks of pain had ceased three days before admission. Two days before admission she had vomited for the first time and she had vomited several times since.

She showed slight rigidity of the right rectus muscle, and there was a rather indistinct feeling of a mass in the region of the right kidney. Cystoscopy was negative. Pyelography showed a normal outline of the kidney calyces. An X-ray picture indicated pericolic adhesions.

A blood count gave white blood-corpuscles, 4800; polynuclears, 64 per cent.



FIG. 1.—Cyst of mesenteriolum The cyst and the appendix vermiformis are included in the same layer of peritoneum The inner wall of the cyst and the inner wall of the appendix are of different structure and are distinct from each other.

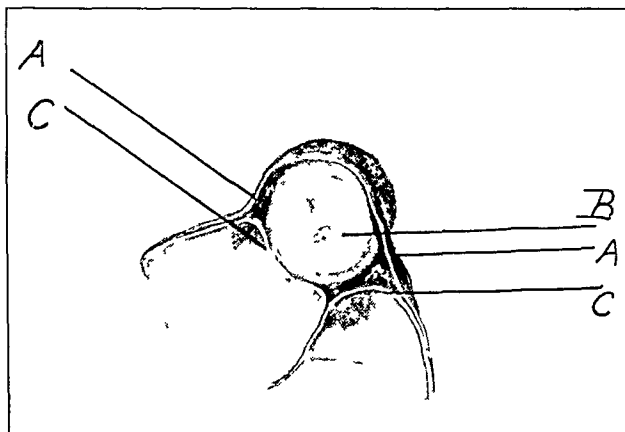


FIG. 2 —Transverse section of vermiform appendix and cyst of mesenteriolum A. Peritoneum of mesenteriolum which also covers the appendix. B. Wall of appendix. C. Socculi of cyst, pushing the layers of peritoneum apart and extending the wall of the appendix

After several days of observation and palliative treatment she still had a sense of discomfort in the appendiceal region, and an operation was done on December 22nd.

The appendix lay high and inward toward the spine; it was incorporated in the wall of a cyst which had a diameter of about 6 cm. The cyst and appendix were removed together. The appearance is shown in Figs. 1 and 2.

Cysts occurring in the various parts of the mesentery are among the rare surgical conditions. There is, however, a fairly steady report of such cysts, and most surgeons see them occasionally. They usually occasion difficulties in diagnosis. As a rule, they are curable by operation. No case has so far come to the writer's notice in which a cyst has occurred in the mesentery of the appendix, but one sees no reason why it should not occur there as well as in other regions of the mesentery, and in all probability many others have been found there.

Doctor White's pathological report is appended.

Macroscopic Examination.—Specimen consists of appendix and cyst. The appendix measures 5 cm. in length and is incorporated in wall of cyst, the tip and distal portion being free, while the larger central portion of appendix is apparently, from external appearance, in the wall of the cyst. The cyst measures 5 to 6 cm. in diameter, is thin-walled and on section contains clear amber fluid. The cyst is bilocular, in that it contains a small cyst of same nature measuring about 2 cm. in diameter and occupying about a third of cystic mass. On section through appendix and cyst it is determined that cyst is not of appendiceal origin, as it is entirely separate from appendix, with no connection with its lumen. The external covering of cyst is continued over external surface of appendix, while the inner lining of cyst, a smooth whitish glistening membrane about .08 cm. in thickness, is reflected over the cystic surface of appendix. The wall of appendix proper measures from 1 to 1.4 cm. in diameter. It is firm and grossly fibrosed. No lumen can be demonstrated. The tissue lying between the external coat and the cyst lining where they divide to include appendix is firm, reddish and evidently a somewhat vascular connective tissue.

Sections.—Two.

Microscopic Examination.—*Section 1* includes appendix, external wall and cystic wall, with included area between as described grossly, with lens examination appearance corresponds to gross description. The appendix proper shows lumen to be very small, lined with normal mucous membrane with submucosa containing few glands and showing encroachment of fibroblastic tissue. The wall shows marked thickening with connective tissue, numerous capillaries and some larger thick-walled blood-vessel areas of fibroblastic proliferations and round-cell infiltration of muscle-coats and wall in general. The area between the surfaces reflected from appendix shows marked round-cell infiltration of tissue with blood. Area is very vascular and somewhat cedematous. The lining of the cyst in places shows a single layer of low, flattened epithelium in some areas of low cuboidal nature, with rather large normal nuclei. The wall of cyst is composed of connective tissue rich in fibroblastic capillaries and is cedematous. The outer portion of wall is vascular and hemorrhagic and infiltrated with round cells. *Section 2* shows the same picture. *Sections 3* and *4* of cyst wall with septum shows same picture of wall as described above.

Diagnosis.—Mesenteric Serous Cyst. Chronic Appendicitis (Obliterative).

PERITONEAL TUBERCULOSIS

DR. FORDYCE BARKER ST. JOHN presented a woman, aged forty-eight years, who was admitted to the First Surgical Division at Bellevue Hospital, June 18, 1919, complaining of pain in abdomen and back.

Patient dated the beginning of her real trouble to the spring of the previous year when her symptoms at this time were coughing, pain in upper abdomen and chest, and fever. Since that time she had had recurrent attacks of acute abdominal pain, at times sufficiently severe as to double her up, accompanied by intermittent diarrhoea and constipation. No blood had been noted in the stools. These attacks were increased in severity by the fact that the patient complained of "having gas which she did not seem to be able to pass per rectum at times," although she belched up a great deal. In the last four months the gas pains have been almost constant, beginning after breakfast, and continuing through the day. Her appetite had been good, but she did not eat because of fear of abdominal distress. Greasy or fried food particularly aggravated the pain, discomfort and gas. Greatest relief was obtained from starvation or hypodermic injection. At times the acute abdominal pain was referred to the right scapular region. She was never jaundiced. She lost thirty-five pounds in ten months. During the past year repeated examinations had been made of her sputum, all of which were reported to her as negative for tubercle bacilli. The chest both by physical and fluoroscopic examinations was negative except for a slight amount of fibrosis. X-ray without ingestion of bismuth revealed an irregularly oval calcareous shadow, 2 by 3 cm., with a dense cortex located in the right iliac fossa about at the level of the interspinous line, suggestive of a large biliary calculus.

The abdomen was opened June 30, 1919. A thin blue gall-bladder, normal in size, with no palpable stones and no adhesions, was found. The pylorus and duodenum appeared normal. The pancreas was normal to palpation. There was an indurated mass of the ileum about 15 cm. long, and 50 cm. from the ileocecal junction, which was firm, presenting a constriction at either end with a very hard mass palpable in the centre. On the surface of the gut were small papillary masses resembling tubercles. The rest of the intestines were normal with the exception of one small area which presented a few scattered tubercle-like papules, but without constriction or thickening of the gut wall. The involved portion of ileum was resected with end-to-end anastomosis.

Pathological Report (by Dr. John McWhorter). *Gross Examination*.—Specimen consists of a resected portion of small intestine measuring 13 by 7 cm. On inspection, there appeared to be two constrictions, both of which are about 2 cm. from the resected extremities. On the serous surface there are a number of small pearly white papules that resemble tubercles. In the mesenteric attachment there is a large circumscribed mass, 2 by 1 cm., which appears to be a lymph-node. On sectioning the ileum longitudinally (Fig. 3) the wall is found to be considerably thickened, averaging 1 cm. The lumen shows two constrictions, between which there is a dilatation having the form, somewhat,



FIG. 3.—Resected portion of ileum thickened by tuberculosis, with retained biliary calculus.

CERVICAL RIB

of a pocket, in which lies a stone, oblong in shape, greenish-brown in color, that measures $1\frac{1}{2}$ by 1 cm. (Fig. 3.) Of the two constrictions the one at the distal end is most marked, apparently resulting in almost complete obliteration of the lumen.

Microscopical Examination.—(1.) Tuberculosis of intestine. (2.) Gall-stone. Analysis of gall-stone.—Biliverdin calcium, bilirubin calcium, and cholestèrin.

Post-operative Convalescence.—The immediate convalescence was stormy; after that the convalescence was smooth. Out of bed on fifteenth day. Wound healed.

Follow-up Note (twenty months after operation).—Patient's weight on leaving hospital was 71 pounds; to-day it is 120 pounds; gain of 49 pounds. No pain; no disturbance of function; well with the exception of occasional belching of gas following ingestion of certain foods, especially fried. Strength is greater than she ever remembers. Appetite good. No cough or night sweats. Bowels move regularly without medicine.

Abdominal Examination.—Scar firm, no tenderness, no masses.

Economic Condition.—Capable of normal amount of work.

The case, Doctor St. Johns said, was presented (1) because of its pathological interest, and (2) because of the satisfactory result of surgical treatment to date.

CERVICAL RIB

DR. EUGENE H. POOL presented two cases of complete cervical ribs with comments on the proper operative technic in those rare cases where symptoms demand operative intervention.

In the first case the anterior method was employed and the rib was of necessity incompletely removed. Although a cure was effected, which may be regarded as permanent since six years have elapsed since the operation, insufficient rib is removed by this method to justify confidence that a cure can be relied upon. In the second case a combination of anterior and posterior methods worked out admirably. The method appears to have features to commend it, especially the fact that the rib is adequately removed.

CASE I.—Female, aged nineteen years. Admitted to the New York Hospital July 22nd; discharged July 31, 1914. Chief complaint was pain and tingling in right hand for six months before admission. Right arm felt numb. The pain and tingling persisted. Patient said that in August, 1913, she fell on the palm of her right hand. There was slight fullness in right supraclavicular fossa. This fullness was evidently bone. The right hand was slightly colder than the left. Right radial pulse barely perceptible, left easily felt. X-ray showed complete bilateral cervical rib.

Operation (July 24th).—Transverse incision three inches long; one inch above clavicle. Dissection exposed rib. Brachial plexus was drawn backward very gently and artery drawn forward with retractors. Rib was cut across as far back as possible. Its anterior attachment to first rib was divided, and the detached portion of

rib was removed. The wound was closed with one drain. On discharge wound healed. Pain had almost disappeared.

Late Result.—Patient has experienced nothing abnormal except that she tires more readily in the right than the left hand; yet she thinks the strength of the two hands is about equal. There has been no numbness nor pain. April 16, 1920, the right pulse still much weaker than left. Strength of two hands about the same.

CASE II.—Female, aged seventeen years, admitted to the New York Hospital April 19, 1920; discharged May 1st. Chief complaints: Weakness of left arm; transitory swelling of left hand; irregular pains and numbness in left arm.

Two months before admission patient noticed that while reading she could not hold a book in her left hand as long as in her right. Soon she found that she could not use her left hand at type-writing as efficiently as her right. She then noticed that her left hand began to swell occasionally. Her hand became slightly blue when the swelling was present.

At about the same time she began to have dull, irregular pains in the left arm. There was a definite, bony, resistance in both supraclavicular fossæ. On the left side there was marked tenderness. X-ray showed bilateral complete cervical ribs.

Operation.—Incision five inches long one-half inch above clavicle. Platysma and deep fascia cut, external jugular being ligated and divided. Posterior edge of sternomastoid drawn mesially; anterior edge of trapezius incised one-half inch and retracted for better exposure. Plexus easily defined by blunt dissection. This led to the surface of the cervical rib. The artery was readily recognized anterior to the plexus. The plexus was then retracted posteriorly very greatly and the artery retracted anteriorly. The rib was freed from muscular attachments without entering its periosteum; the intercostal muscles below and attachments of scalenus anticus and medius being freed. The dissection was carried backward beneath the plexus and forward to anterior attachment of rib.

The parts were allowed to fall together and the skin and fascia were freed at posterior part of wound and retracted well upward. A vertical incision was made through the muscles; namely, trapezius and levator anguli scapulæ, so that the angle of the rib was easily exposed. With bone forceps it was cut across without difficulty; with the tip of transverse process. Through the anterior portion of the wound the anterior attachment of rib was then cut, also with bone forceps. In neither case could a Gigli saw be used on account of the depth of the fact that anteriorly the rib was so overhung by sternomastoid and artery that the Gigli could not be used safely. Special care was taken throughout the operation to avoid injury to the pleura. Having cut both ends, the rib was readily drawn through the posterior incision. Wound closed without drainage. Convalescence uneventful. Wound healed per primam.

Late Result (September 5, 1920).—Patient feels well. No weak-

THE USE OF THE DUODENAL TUBE IN PREOPERATIVE STUDY

ness in left arm. No swelling. General condition good. Three weeks after leaving hospital she returned to work. Scar well healed. No nervous symptoms. No limitation of motion; no tingling nor numbness of arm.

To ensure a permanent cure Streissler claims that the rib should be removed back to the vertebra and that its periosteum should also be removed; otherwise regrowth of bone is likely to occur and to cause recurrence of pressure symptoms.

By a combination of anterior and posterior methods of approach as through one incision used in our second case the ribs may be adequately removed and permanent cure effected.

THE USE OF THE DUODENAL TUBE IN PREOPERATIVE STUDY

DR. A. O. WHIPPLE read a paper with the above title, to be published hereafter.

DR. ÁRPAD G. GERSTER said that in 1912 he had read a paper before the Chicago Surgical Society on "Unsuccessful Biliary Surgery," in which paper in analyzing the causes of failure he had necessarily to dwell on fundamental questions of biological pathology, and on the obscurity of the knowledge regarding the mechanical function of such an important factor as the sphincter at the papilla Vater. Collating all that was then known, he ventured to suggest, basing theory upon analogous phenomena observable in other sphincters, that retention within the biliary tract may be primarily caused by alterations of the function of the sphincter of the choledochus. In the beginning, there may be periodic spasms induced by chemico-mechanical irritation of those nervous elements of the duodenal mucosa which preside over the reflex contractions of this sphincter. If this condition becomes chronic, hypertrophy, followed by degeneration of contractile elements and the deposit of rigid scar tissue, may end in more or less complete stenosis—or even in stenosis combined with insufficiency, which, permitting regurgitation, will produce infection of the biliary ways.

Diagnostic shortcomings are the real cause of most of our failures. Of these, a respectable portion is due to lack of diligence in observation, and to failure to acquire and utilize the known means for arriving at a dependable diagnosis. Foremost of all is the omission of a careful examination of the biliary channels at the time of operation. Thus the gross mistake of leaving behind undetected calculi is incurred. But not all the fault is chargeable to the individual practitioner. It must be looked for also in our imperfect knowledge of even such a gross item of physiology as is the function of a sphincter. To do better by our patients we must know more about the normal and morbidly altered work of the sphincter of the papilla of Vater.

The discussion on his paper at Chicago was opened by Dr. Frank Billings. He paid to its reader a compliment—in his opinion the highest

that could be paid to a surgeon—which compliment he now took the liberty of passing on to Doctor Whipple. He said that "Our guest is really a physician who happens to practice surgery also." Besides approbation, this remark implied a goodly amount of irony which he was sorry to say was not always misplaced. He thought that it was far too much exaggerated in such a remark as that made by the late William H. Draper to Doctor Sands, that surgeons are, after all, nothing but "bone carpenters." The writer himself had sinned in this direction when, in discussing their derelictions, he warned his colleagues against short cuts suggested by grossly mechanical views entertained about the practice of surgery. Jocularly he ventured to call modern surgery a sort of exalted plumbing. Plumbers' work was mainly concerned with tubular systems; so was that of the modern surgeon, nine-tenths of whose work dealt with disorders of the tubes of the respiratory, digestive, urogenital, and vascular tracts.

In 1917 Dr. Samuel Meltzer, basing his proposition upon observations regarding the direct effect of sulphate of magnesia upon the sphincter of the choledochus, suggested this chemical's methodical application by means of the duodenal tube for diagnostic and possibly for curative purposes. Directly from this flowed such meritorious work as that of D. B. Lyons, of Philadelphia, and the series of important observations laid down in Doctor Whipple's paper. Their value has a surprising importance. Our ability to ascertain by a simple method whether or not the cystic duct be open is of the greatest aid in forming rational therapeutic indications. But even more good may eventually come from this method. It represents the first genuine cholagogue. All those mentioned in pharmacology before this were shams. This method may develop into a means of effective drainage of the entire biliary tract, a drainage which may be of real use in dealing with those intractable and dangerous forms of biliary infection and retention, known under the rather too comprehensive and chaotic term of cholangitis.

DR. WILLY MEYER said for the first years Doctor Einhorn had been using his duodenal tube principally in a therapeutic way, for the purpose of putting the stomach as well as the first portion of the duodenum at rest and feeding a patient with gastric or duodenal ulcer by this means for a number of weeks. As he worked with the tube, naturally his work broadened and the tube soon came to be used as a diagnostic agent, particularly in diseases of the bile system and pancreas. He had had the privilege of following this work because it was done at the Lenox Hill Hospital. They had often discussed many questions, among them whether it would be possible to diagnose more definitely gall-bladder inflammation without stones. If to the means we had to-day for diagnosing gall-bladder disease with stones could be added means of diagnosing gall-bladder disease without stones, it would be a great advantage. For the examination of gall-bladder disease with stones we had, of course,

the history of the patient and clinical examination, also the X-ray; but stones in the gall-bladder might be shown by the X-ray in only 15 or 20 per cent. of the cases. In his discussion he would limit himself to the diagnosis of cholecystitis without stones.

Cholecystitis without stones, Doctor Meyer said, was, as he believed, the precursor of cholecystitis with stones; if diagnosis of cholecystitis without stones could be made the diagnosis of cholecystitis with stones could also be made. For the past three to four years Doctor Einhorn and he had been investigating cholecystitis without stones with the duodenal tube, and he could claim that they had done this before Doctor Meltzer published his hypothesis of the action of the magnesium sulphate solution, the test which had now entered every clinic and hospital in our country, and perhaps abroad. It would be found that constant pain in the upper abdomen soon after meals in the great majority of cases was due to gall-bladder disease provided the X-ray failed to prove disease of the stomach and duodenum, and if the duodenal tube had also excluded disease of the pancreas. Doctor Einhorn favored examination of the duodenal contents with the patient in the fasting condition. He believed that was better than examination with the help of magnesium sulphate instillations. With reference to the bacteriology, he would mention the work of Doctor Garbat, the serologist at the Lenox Hill Hospital, New York, who had done the same while in the service with the hospital's unit at Biltmore. He found that in the fasting condition one could nicely obtain proof of the type of bacilli present in the duodenal contents. For this work Doctor Garbat received the Cartwright prize given by Columbia University.

At the Lenox Hill Hospital they had aspirated the gall-bladder and then had had cultures made. They had published observations on eighteen cases of cholecystitis without stones in which the gall-bladder was subsequently removed. The contents of the duodenum were previously examined, but magnesium sulphate instillation was done in but a few cases. They had been amazed to find the bile aspirated from the gall-bladder frequently sterile; but tissue culture examination of the gall-bladder walls showed that the latter contained the bacteria. Aschoff had made an exhaustive examination of gall-stones years ago and usually found bacteria in the centre of the stones. So it seemed that cholecystitis without stones was the precursor of cholecystitis with stones. That the bile so often was sterile might be due to the effect of the bile upon the bacteria. They would then be found in the gall-bladder wall.

DR. HOWARD LILIENTHAL stated that Doctor Crohn was doing this work in his service at Mt. Sinai, and he had operated on some of these patients. There had been one mistake in the observation of these patients by Doctor Whipple as by other workers, and that was that the examinations of the duodenal contents were not made often enough. If one introduced the tube and made the observations when a patient came

into the hospital and then before operation, after he had been cared for and purged, there might be quite a difference in the findings. Not only that, but he felt quite certain that the first gush of bile would be very much more apt to contain bacteria than bile collected several days later. If the magnesium sulphate caused the relaxation and the bile ran out from the gall-bladder, the first bile might contain more bacteria, because it would come from the neck of the gall-bladder where there was apt to be irritation by stones or stricture or by the pressure of the bile trying to force its way out.

Doctor Lilienthal suggested that in continuing the work examinations be made several days apart and the results compared. Fifty per cent. of success was not enough in a method of this kind which he believed promised well.

DR. GEORGE WOOLSEY said, in regard to the patient with absence of the gall-bladder which Doctor Whipple had shown, he had recorded in a paper read before the Society in October, 1920, in which also three faceted stones were found in the common duct, and he was unable to find any gall-bladder and there was no cystic duct. Doctor Schachner in the ANNALS OF SURGERY, in 1916, had reported seven cases of total absence of the gall-bladder.

The use of the duodenal tube was most valuable in connection with the diagnosis of cholecystitis without stones. It was interesting to prove by the absence of the "B" bile, so-called, the closure of the cystic duct, or by the absence of the "C" bile, the closure of the common duct, but this was not of much material assistance; it might be of help in connection with the examination of the enzymes of the pancreas in the diagnosis between impacted stone and a carcinoma of the pancreas. So far as the result of the enzyme examination went, it did not seem to correspond very closely to the gross condition of the pancreas as determined by palpation.

Stated Meeting held February 23, 1921

The President, DR. WILLIAM A. DOWNES, in the Chair

CONTUSION OF ILEUM. SLOW PERFORATION. SUTURE. RECOVERY

DR. SEWARD ERDMAN presented a man, thirty-eight years of age, an employee of the City Fire Department. While attending a fire he fell from one wall to another, landing on all fours, then rolled off this parapet, landing on his back and left hip. He could not recall striking his abdomen at any time. He experienced severe pain in the spine, left hip and foot, and a sense of soreness in the abdomen, but was able to get up and walk with assistance. He did not vomit. Physical examination on admission to the Second Surgical Division of the New York Hospital, November 8, 1920, a half hour after the accident, showed no sign externally of injury to the abdomen, which was scaphoid and held somewhat

LACERATION OF DUODENUM

rigid; there was no definite local tenderness. Ecchymosis was present over the dorsolumbar spine; there was hæmatoma of the left tibia and foot, and a number of abrasions of the head. There was no blood in the urine. The temperature was 100.6° F. and the pulse 68. The following day the white blood count was 14,600, and polymorphonuclears, 70 per cent. For two days after admission the patient seemed to improve; the abdomen became soft, and the temperature descended to 99° F. About fifty hours after admission he was seized with severe pain in the abdomen and thereafter vomited several times. On the next day, November 11th, he appeared more ill, the abdomen was held rigid, and there was marked tenderness to the right of the umbilicus. The temperature was 101° F.; pulse, 70; white blood-corpuscles, 19,000; and polymorphonuclears, 87 per cent. The X-ray of the diaphragm was negative.

November 11th a paramedian incision was made, starting above the umbilicus and extending well down until the site of the pathological condition was revealed. The peritoneum was markedly reddened, and distended coils of small intestine presented, in places translucent enough to show the fluid within. Blood-tinged serous fluid was encountered everywhere, but in no great quantity. Palpation did not reveal the site of obstruction; the distended bowel was then followed downward until a sharp kink acting as an obstruction was revealed in the lower ileum. At this point there was rather more bloody exudate, the ileum was folded over sharply to the left and attached firmly to the left leaf of the mesentery on the body of the fifth lumbar vertebra. Stellate hemorrhagic areas in the mesentery here indicated trauma. Upon dissecting the bowel free it was seen that a small perforation, approximately 3 mm., on the convex surface of the bowel had occurred and there was a loss of some of the surrounding serous coat. The obstructive symptoms, caused by the sharp kink, were relieved upon freeing the bowel. The perforation was closed with a purse-string chromic suture and the raw surface covered with transverse suture of its serosa. Owing to the peritonitis already present, drainage seemed indicated. The wound was closed in layers, using silkworm gut and silk for the skin.

The wound discharged foul, colon-smelling pus, and was laid open superficially on November 17th and Dakinization employed. The patient was discharged on December 6, 1920, with the wound healed save for a small granulating area flush with the skin.

LACERATION OF DUODENUM. RUPTURE OF LIVER. DUODENAL FISTULA. JEJUNOSTOMY FEEDING. PAROTIDITIS. RECOVERY

DR. SEWARD ERDMAN presented a man, aged twenty-five years, a chauffeur. About ten minutes before admission to the Second Surgical Division of the New York Hospital, November 16, 1920, he was injured in the following manner: While standing behind his truck another automobile struck him in the back, pinning him against the level tailboard

of his own truck, and causing the corner of the board to impinge on his epigastrium. He immediately experienced severe pain in the epigastrium and vomited stomach contents without blood. His previous history was negative, except that in 1917 he was operated upon for an "abscess" of the left "shin bone." Physical examination showed several abrasions across the epigastrium. The abdomen was retracted and markedly rigid in the upper half, with maximum tenderness to the right of the mid-line. There was no blood in the urine. The blood count showed red cells, 4,900,000; hæmoglobin, 90 per cent.; white blood-cells, 12,000; polymorphonuclears, 71 per cent. The provisional diagnosis was rupture of the liver.

Two and one-quarter hours after the accident an exploratory paracentesis was carried out with trocar and cannula in the mid-line below the umbilicus, with negative results. A transverse incision above umbilicus was then made. This kind of incision was selected on account of the definite upper abdominal trauma. Upon opening the peritoneum no fluid and no gas were encountered. The transverse colon presented and appeared blue in the region of the hepatic flexure where a large hæmatoma in the mesocolon was seen. Above the colon, beneath the liver, there was a moderate amount of blood, and a small, still bleeding vessel was seen in the gastrocolic omentum, close to the antrum pylori. This was doubly ligated. More blood was found beneath the liver, and upon raising this organ a laceration 7 cm. in length by 2 cm. wide, continuous in direction with the longitudinal fissure, was seen. This was oozing slightly. It was closed with deep plain gut sutures. The hepatic flexure was now turned downward to study the hæmatoma. When seen from above the transverse mesocolon was distended not only with blood, but with imprisoned froth-like bubbles of gas. This retroperitoneal emphysema, of course, seemed to indicate bowel rupture, and the traumatized colon was first examined for perforation. None was found. Deeper opening of the transverse mesocolon revealed more gas coming from a rent in the duodenum as it crossed the vertebral column. The tear was nearly transverse and approximated 2.5×1 cm. This was repaired with a double layer of chromic sutures. Connected with the torn bowel was a small firm strand leading to the pancreas—possibly an accessory pancreatic duct. No further injuries were encountered and the wound was closed in layers, using silkworm gut and silk for the skin. Two cigarette drains were introduced toward the duodenal suture.

For five days following operation there was a moderate serous discharge. On the sixth day a profuse discharge from the wound occurred in gushes about ten minutes after the ingestion of fluids. Evidently after holding for five days the duodenal rupture had sloughed open. The patient was put on continuous suction. On the seventh day 4000 c.c. of fluid was collected from the wound. The patient was still receiving fluids by mouth.

At a second operation, on the eighth day (November 24th), a jejunos-

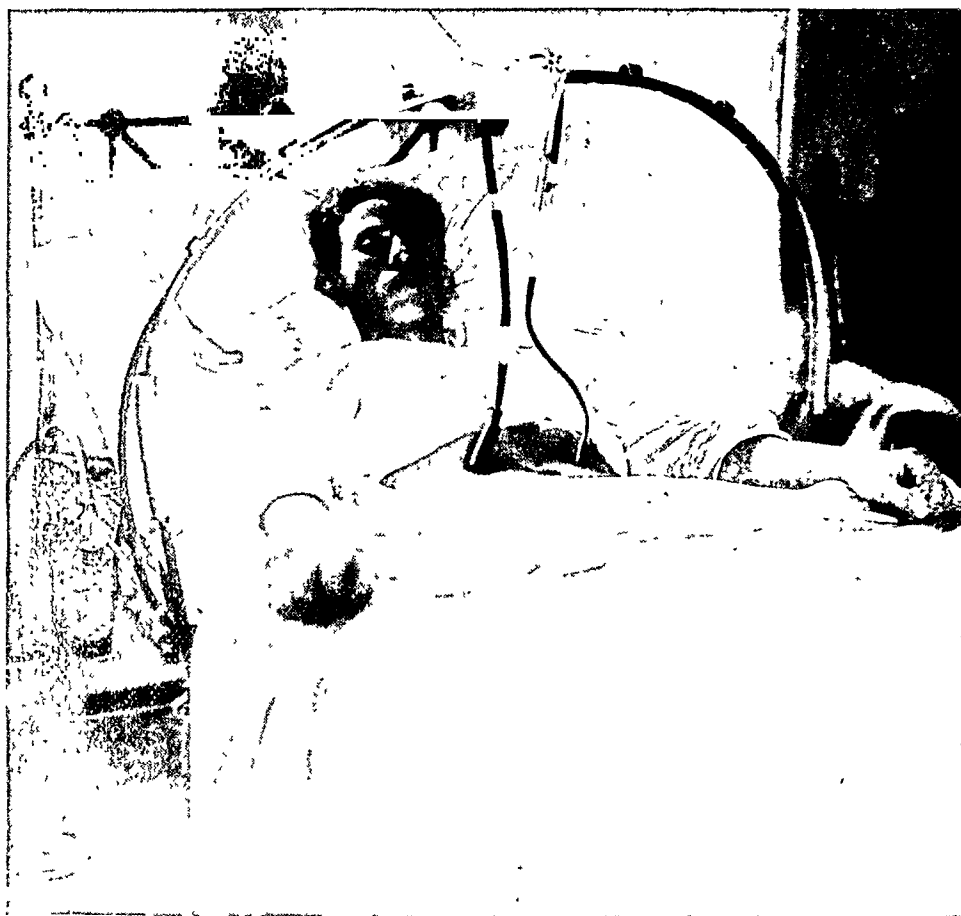


FIG. 4.—Apparatus used for continuous aspiration and collection of duodenal secretions; also jejunostomy feeding tube receiving saline.

LACERATION OF DUODENUM

tomy was performed under local anæsthesia. From the ninth to the twenty-second day feeding was entirely by the jejunostomy tube. The duodenal fistula persisted from the sixth to the eighteenth day, when it spontaneously closed. For the first eight days the daily output of the secretions collected was between fifty and sixty ounces.

A left parotitis appeared on the eighteenth day and threatened to cause suppuration, but resolved entirely in fourteen days, resolution being helped by probing Stenson's duct. On the twenty-fourth day the jejunostomy tube was removed and no leakage occurred. Both wounds closed promptly and on the thirty-fourth day the patient was discharged with only granulating areas.

The jejunal feedings were two-hourly eight-ounce meals, consisting of olive oil, milk powder and glucose mixed with the entire secretion from the fistula. In the intervals saline by the Murphy drip was introduced into the jejunum. No irritation of the skin occurred about the fistula. The patient was discharged cured on December 20th and at that time weighed 115 pounds. On December 30th he weighed 130 pounds.

The parotitis was probably incited by stagnation and concentration of the saliva during the long period in which no fluid nor food was given by mouth. To rectify this salivary inactivity the patient was later encouraged to use chewing gum.

The accompanying illustrations (Figs. 4 and 5) show the method employed to attain continuous aspiration of the duodenal secretions, which entirely prevented excoriation of the skin and permitted collection in a sterile bottle at the side of the bed, for later administration with feedings.

The jejunostomy tube with its suspended glass funnel is being used for the Murphy drip instillation of saline solution in the intervals between the jejunal feedings.

The various tube connections are held in position by the Pool frame, which is much in use in the Second Surgical Division of the New York Hospital.

This frame, designed by Dr. Eugene H. Pool, consists of a tubular and partly semitubular iron frame with holes placed at intervals in its floor to accommodate the small elbow-shaped metal tube connection.

Arching across the bed it allows adjustment of drainage tubes at any angle without possibility of kinking or compression; at the same time it allows the patient freedom of movement, supports the bedclothes and facilitates dressing of the wound and attention to the patient by the nurse. The height is readily adjusted by means of the bed clamps.

The same principle of aspiration, with or without irrigation, is applicable to cases such as suprapubic cystostomy, biliary fistula, peritoneal and pelvic abscesses, etc.

DR. WILLIAM A. DOWNES stated that he had had the misfortune to operate on a case of retroperitoneal rupture of the duodenum in which he believed the fatal outcome was due to operating too soon. The patient

was a man who had been kicked by a mule and Doctor Downes had performed the operation within three-quarters of an hour after the accident. The man had all the symptoms of perforation, exquisite tenderness, rigidity and shock, and it was thought that he had sustained a severe abdominal injury. Upon opening the abdomen a small amount of hemorrhage was found around the free margin of the liver and the pyloric end of the stomach, and the first portion of the duodenum was somewhat congested. There did not appear to be gas or free fluid behind the peritoneum, although a careful search was made. A careful search was also made for an opening in the gut, but none was found, and it was finally

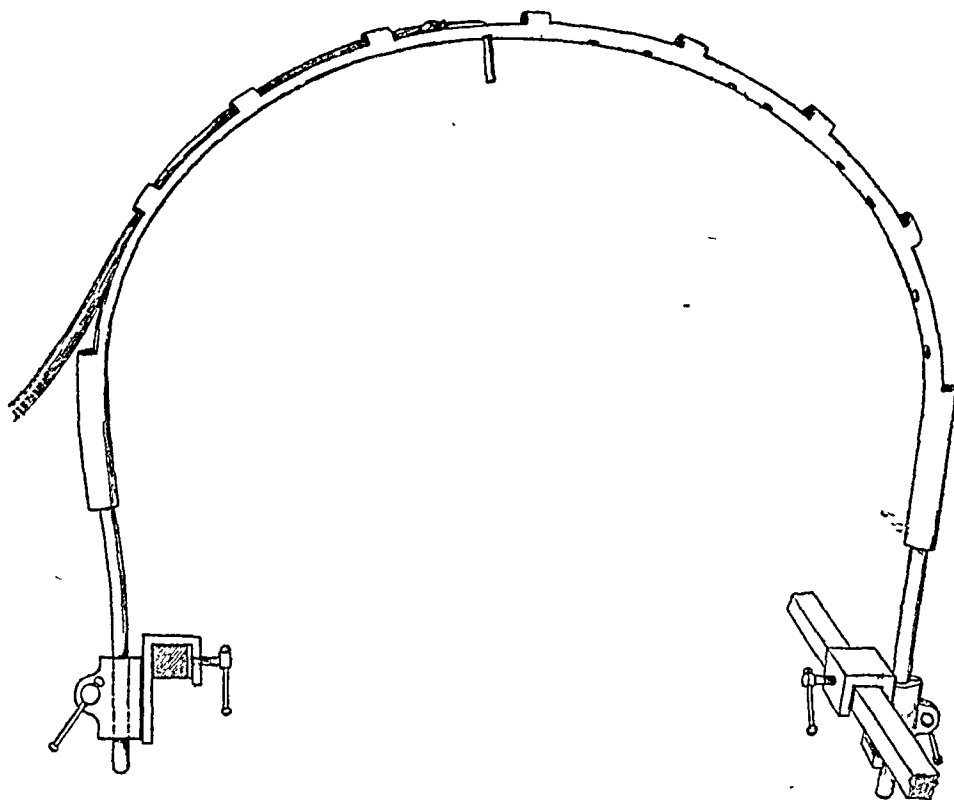


FIG. 5.—Frame support for drainage tubes, designed by Dr. Eugene H. Pool and in use in the Second Surgical Division of the New York Hospital.

concluded that the symptoms were due to shock and that the little fluid came from the liver. The incision was sewed up and the man did well for forty-eight hours, when he began to run a temperature and the right side of the abdominal wall began to show œdema and infiltration. He went along for two or three days in about the same condition and then suddenly developed symptoms of general peritonitis and died. At autopsy a retroperitoneal rupture of the duodenum was found. Doctor Downes said he felt that if he had waited two or three hours until some infiltration had occurred there might have been some evidence of retroperitoneal leakage.

DR. JOHN DOUGLAS stated that he had seen three cases of traumatic rupture of the duodenum. The first of these patients he saw at Bellevue

EPITHELIOMA OF THE DURA

Hospital two years ago. This man had been caught between two freight cars and sustained an extraperitoneal rupture of the duodenum which was easy to locate at operation. The second case was that of a man who fell from a roof and apparently had sustained an abdominal injury, though there were none of the usual signs of intestinal perforation. The man died some eighteen or twenty hours after admission. At autopsy (it was a coroner's case) a lesion was found retroperitoneally in the region of the appendix. This was traced up and a small retroperitoneal lesion found in the duodenum. He thought that the lesion was such that at operation no one would have been able to find it; it was very difficult to find this small lesion even at autopsy. This man also had a fracture of the skull. So he felt that Doctor Downes need not regret having operated too soon.

A third case of rupture of the duodenum he saw at the Knickerbocker Hotel. This patient was shot with a bullet that entered the upper abdomen anteriorly and came out posteriorly. A second bullet pierced the lung. At operation a wound of the jejunum was found and sutured. The patient died, and it was difficult to say whether she died from pneumonia or from general peritonitis. At autopsy a retroperitoneal perforation of the duodenum was found that was not discovered at operation. There was nothing more difficult at the time of operation than to make out a retroperitoneal injury to the duodenum.

CHINOSOL AND NORMAL SODIUM CHLORIDE AS WOUND DRESSINGS

DR. WILLIAM C. LUSK presented a man recovered from an extensive cellulitis of arm and forearm, in the treatment of which a solution of 2 per cent. chinosol and normal sodium chloride had been used. This case will be reported in a writing now in course of preparation.

FIBROSARCOMA OF THE APPENDIX

DR. GEORGE H. SEMKEN presented a man from whom he had removed a fibrosarcoma of the appendix. He accompanied the presentation with remarks upon that condition.

EPITHELIOMA OF THE DURA

DR. CHARLES A. ELSBERG presented a man, aged forty-five years, a patient of Dr. S. P. Goodhart, of New York City. For several years the family had noticed changes in the patient's temperament. He had shown a greater degree of excitability and impatience at home and in his business relations. During this time also he had been troubled by frequent dreams from which he would suddenly awaken and from which it would take him some time to return to normal consciousness. He began to have severe headaches with attacks of vomiting which became gradually more and more severe. The eye grounds remained negative until about one week before operation, when a rapidly advancing papilloedema showed

itself. There were slight signs referable to pyramidal tract irritation on the right side. The X-ray examination showed a few small slightly irregular areas of bone absorption in the left frontal and parietal bone. The diagnosis of tumor in this area was made and operation performed in May, 1919, by Doctor Elsberg. A large osteoplastic flap with its base in the temporal region and exposing the parietal and temporal adjoining regions, was turned down and the dura widely opened. There was a moderate increase of intracranial pressure. As soon as a dorsal flap was reflected, a brown tumor mass was to be seen in the upper and anterior parts of the exposed cortex. Over the central part of the growth the dura was firmly adherent to it. The limits of the tumor were well defined, and after the ligation of a number of pial blood-vessels the tumor was freed on all sides. It was buried to a depth of 5 cm. in the cortex, *but it was well encapsulated, so that it could be peeled out of its bed with little hemorrhage.* One large blood-vessel, evidently the nutrient vessel of the tumor, which entered the growth on its under surface, was ligated and divided. The sides and bottom of the cavity from which the tumor was removed consisted of very vascular cortex, and the brain tissue gradually filled up the cavity. The dura was closed, bone flap returned to place and scalp sutured. The wound healed by primary union, the scalp sutures being removed on the eighth day. The tumor was reddish brown in color, irregular, lobulated, and of very firm consistency; it measured 7 x 5 x 6 cm.; microscopically it was a typical endothelioma. Recovery from the operation was very satisfactory; papillœdema rapidly disappeared, and the patient felt perfectly well and has remained well up to the present time.

A second patient, also presented, was a man referral by Dr. Frederick Tilney and operated upon at the Neurological Institute, September 29, 1920. The patient began to have cramps with feeling of deadness in the right upper extremity in the summer of 1918. He was left-handed. The attacks occurred every four or five weeks without other symptoms, up to the beginning of 1920. He then began to suffer from headache with vomiting and began to notice that his vision was not as good as it had been; the headaches became more frequent and more severe, and by March he noticed that he felt queer mentally and frequently did not realize where he was. At about this time he began to drag the right foot and noticed that he had lost much power in the right arm. By September the weakness in the right arm and leg was very distinct. He had a high grade of choked disk. His mental condition was peculiar in that he seemed to be more or less in a dream and would answer questions with some difficulty. There was no speech disturbance, but the patient was very emotional, laughing or crying without cause. At operation Doctor Elsberg turned down a large osteoplastic flap. When the dura was opened a large tumor, measuring 7 x 6 cm., was exposed on the surface of the cortex. The tumor was removed with little difficulty. The patient

CEREBELLAR CYST

recovered very satisfactorily from the operation, excepting for the unusual fact that the papilloedema persisted for three months before it disappeared. He was presented perfectly well and free from all symptoms.

CEREBELLAR CYST

DR. CHARLES A. ELSBERG presented a girl, aged eleven years, a patient of Doctor Tilney, who had been operated upon in 1912, eight years before, for a right cerebellar cyst, by Doctor Cushing. She recovered very satisfactorily from the operation and remained well until March, 1920. She then began to complain of severe headaches, of difficulty with her sight, and had frequent attacks in which she became very pale and often lost consciousness. The symptoms became gradually worse, and by the beginning of April there were marked signs referable to the right cerebellum. She was operated upon by Doctor Elsberg April 30, 1920, the right cerebellum was exposed through a typical cross-bow incision, and was found to contain a large cyst, the contents of which consisted of yellow fluid. On the inner surface of the cyst were several small projections having the appearance of typical gliomatous knobs. The inner wall of the cyst was cauterized with clear carbolic acid, and the wound closed in the usual manner. Recovery from operation was uneventful. All of the child's symptoms disappeared within a few weeks and she has remained perfectly well. The unusual feature about this case was the long interval between the first operation and the recurrence of symptoms.

EXTRACEREBELLAR TUMOR

DOCTOR ELSBERG presented a woman who had been operated upon for a large extracerebellar tumor involving the vermis and the upper surface of the cerebellum. The patient had been referred to the Neurological Institute by Doctor Osnato, of New York, with the diagnosis of vermis tumor. She was markedly ataxic and emaciated, with a high grade of choked disk and with all the typical symptoms of expanding lesion in the right side of the posterior fossa. At the operation a large endothelioma, the size of a lemon, was removed. It was attached to the dura at the location of the confluence of the sinuses and was removed with great difficulty. A small bit of tumor remained attached to the region of the confluence of the sinuses and was cauterized with pure carbolic acid. The patient recovered very satisfactorily from her operation. Within six weeks all of her symptoms had disappeared, and she has remained well up to the present, more than one year after the operation.

BOOK REVIEW¹

A MANUAL OF SURGERY. By FRANCIS T. STEWART, M.D., Philadelphia, P. Blakiston's Son & Co. 8vo., cloth, pp. 1086.

This book appears as the fifth edition of a work which is intended for students and for general practitioners. It is a true text book of surgery, all phases of which are considered briefly and naturally more from the standpoint of diagnosis than from the standpoint of technical treatment, although the technique of the common operative procedures, such as herniotomy, thoracotomy, appendectomy, gastroenterostomy, etc., is given in considerable detail.

In describing the various techniques for the operations, the author names and submits the usual method, or methods, employed. He then concludes the discussion in many instances with a description of his own favorite method. For instance, in doing a radical mastectomy he advises the use of a transverse elliptical incision, which is, I believe, not as commonly used as some modification of the vertical incision. In doing a gastrostomy, a very clever yet simple method of producing a permanent tract (leading from the exterior into the stomach) that is completely surrounded by normal skin is described. That Dr. Stewart advocated and used celluloid thread as a suture material is evident from reading his text.

Some of the diagrams are quaint and somewhat old-fashioned, but they are pertinent and illustrate well the subject under discussion. There are, however, many very excellent modern plates found all through the book.

As a whole the work has been brought up to date, not only by the author before his death but also by Dr. Walter E. Lee, who has, moreover, added much that is of value on the subject of Military Surgery.

In conclusion, the reviewer considers that this book on the essentials of surgery will be found to be of greatest value to the undergraduate, whose time cannot be spared upon its unessentials. To the general practitioner, who seeks a guide to present-day surgical conditions, their diagnoses, and treatment, it should be a great comfort. To any medical graduate who aspires to maintain a good working library this surgery, which omits historical matter and bibliographical references, but which lays emphasis on those details which vast experience has taught to be of greatest clinical importance, will find on his shelves a welcome place.

MERRILL N. FOOTE.

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Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY

227-231 S. 6th Street

Philadelphia, Penna.

